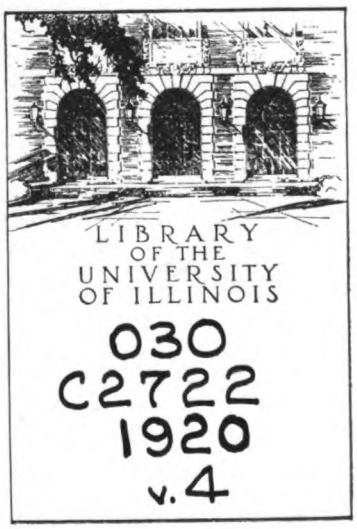
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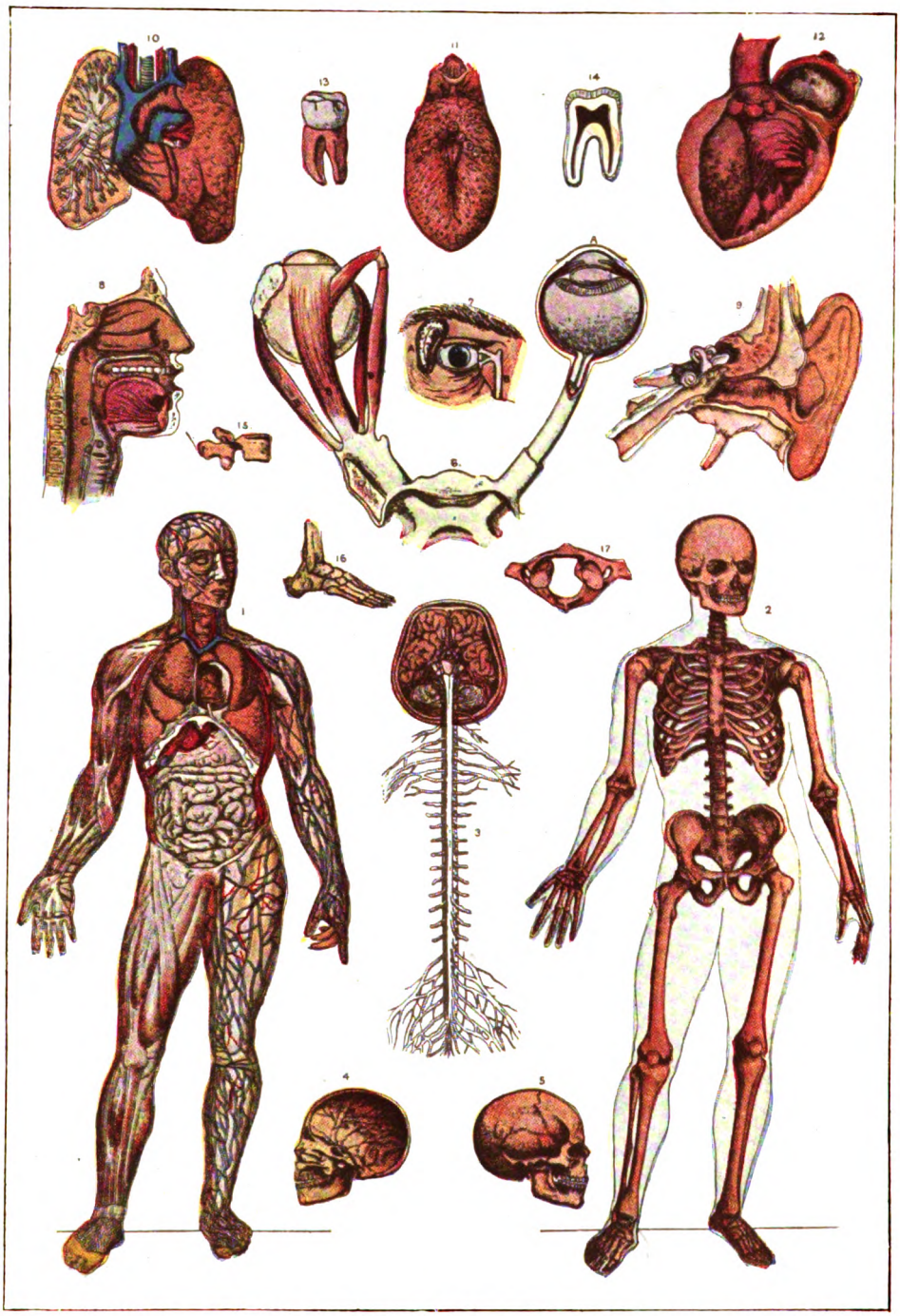

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1. The Human Body with the anterior walls of the chest and abdomen removed. In the left arm and leg the superficial veins are seen; in the right arm and leg the dissection has been carried further so as to expose the muscles; 2. Human Skeleton; 3. The Brain (from below) and Spinal Cord; 4. The inner aspect of the right side of the Human Skull; 5. Outer aspect of the same; 6. The Eyeballs—A, section; B, muscles; 7. The Right Eye showing—A, lachrymal gland; B, lachrymal duct; 8. Vertical section showing —A, mouth; B, nasal passages; C, pharynx; and D, larynx; 9. The Ear; 10. Heart and Great Vessels and Lungs; 11. The Tongue; 12. The interior of the Left Side of the Heart—A, left auricle; V, left ventricle; 13. Tooth; 14. Vertical section of Tooth; 15. Vertebra (side view); 16. Bones of the Foot; 17. The "Atlas" Vertebra.

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Continued from Vol. III., page 448.

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PHILOSOPHY.—III

MODERN materialism may be said to have arisen in the latter half of the eighteenth century. In the era of the French revolution the general insurrection against tyranny, privilege, tradition and authority in the political, social and religious worlds was not without its effects upon philosophical thought.

Materialism

The crude materialism of that time is well reflected in the saying of the French physician Cabanis: "The brain is determined to thought as the stomach is to digestion, or the liver to the bile." Eighteenth century materialism is fully set out in a work called *Le système de la Nature* (1770) which bore the name of Mirabaud, but is commonly ascribed to Holbach assisted by Diderot, Grimm and others. According to it, matter and motion are inseparably associated and constitute the sole content of reality. Motion is either attraction or repulsion, all movements are compounded of these two, and through them originate the different forms of matter and the totality of all phenomena. The laws of these motions and of the forms of matter are immutable and eternal.

The next stage in the development of materialism, which dated from the middle of the nineteenth century, owed its origin to the sensational advances made by scientific discoveries. The views of the time are to be found in the writings of Vogt, Moleschott and Büchner. The *Kraft und Stoff* (Force and Matter) of the last-named had probably the widest circulation of any popular work on philosophy ever written.

From 1885–1888 it passed through sixteen editions in Germany and was translated into thirteen foreign languages in many of which numerous editions also appeared. Although for the most part attractively and clearly written, it bears evidence that the author himself was not clear in his own mind as to the relation of matter and mind. Thus in one place thought is said to be motion; in another, thought is the effect of motion.

Spinosa's Philosophy

In the 16th edition Büchner states that "thought and extension can only be regarded as two sides or two aspects of one and the same phenomenon, the true nature of which is unknown to us." Here he does not assert the omnipotence of moving matter nor dissolve away consciousness into intangible vibrating molecules, but he postulates the existence of an unknowable something which appears to us under two forms—matter and mind. This view, as we shall shortly learn, is the fundamental proposition of the philosophy of Spinosa.

With the exception of this passage, we

may say that the position of the materialism of that time was that all phenomena without exception could be explained by deduction from the known properties of matter in motion. The equation of reality was solved by eliminating the unknown "*x*" of consciousness and substituting for it the known factors of matter and motion.

The next development was primarily due to an able group of workers in the field of natural science of which the biologist Huxley, the physicist Tyndall and the physiologist Dubois Raymond were the most conspicuous. By dint of their vigorous personalities, their inimitable powers of exposition and their standing in the scientific world, this band of stalwarts compelled the attention of all thinking men and created a veritable fracas in the camp of their opponents—tradition and authority. They maintained that matter and mind were for us ultimate realities in themselves and as such are incapable of explanation, and that the precise mode of connection between them is beyond the possibility of human knowledge.

Huxley and Tyndall

Huxley and Tyndall are very often spoken of as materialists, but the term is not justifiable and they themselves rejected it. They admitted that consciousness was a function of matter, i.e., an effect or result of the activity of matter, that the latter can exist independently of mind and preceded it in point of time, but they would not countenance any attempt to explain away mind in terms of matter or motion, in fact consciousness was to them of even more importance than matter, because matter is only known to us through the intermediation of mind.

In a letter to Charles Kingsley, Huxley wrote, "Materialism and spiritualism are opposite poles of the same absurdity—the absurdity of imagining that we know anything about spirit or matter." In so far as they accepted the tenets of materialism which were supported by science, they may be labelled "scientific materialists." but their main position was one of *agnosticism*, i.e., of "don't know." Matter is in the last resort unknown and unknowable ; mind is equally unknown and unknowable ; and although it is possible to postulate some sort of connection between the two, the nature of that connection is as much behind the veil as is the nature of mind and matter themselves. Thus they slammed the door upon ontology, and would-be seekers after truth were enjoined to confine themselves to matters which were capable of being investigated—the problems of positive science.

The most formidable weapon which spiritualism wields to slay her adversary is borrowed from the armoury of that epistemological doctrine called Idealism. All our knowledge of external objects is simply the knowledge of our own mental states.

Spiritualism

There is no object without a subject, no matter without a mind to perceive or conceive it, sensation and thought are necessary pre-existing conditions for the existence of a material universe. This point of view is very well given by Schopenhauer in an imaginary conversation between Matter and Mind, or Object and Subject.

Subject.—I am the only reality, nothing exists apart from me. The world exists in my consciousness.

Object.—Presumptuous illusion ! I am the one and only, beyond me is nothing. The world is my transitory form. You are merely the manifestation of one side of this form and are entirely accidental.

Subject. — What foolish ignorance ! Neither you nor your form would exist without me ; I am the condition of your existence. If you imagine me as non-existent, and then believe you are capable of thought, you deceive yourself mightily : for your existence apart from my consciousness is a palpable contradiction. That *you* exist, means merely that *you* are represented in my mind. My consciousness is the *habitat* of your existence, and therefore I am its primary condition.

Object.—The presumptuous nature of your argument can fortunately be proven in a very real manner, and not merely by a show of words. In but a few moments you will be no more, you and all our prattle will disappear into oblivion, like a fleeting shadow you will share the fate of all my transitory forms. I, however, remain, unaffected and undiminished, from æon to æon, throughout eternity, and gaze with unruffled mien upon the drama of the vicissitudes which my forms undergo.

Subject.—That eternity of which you boast, like the infinite space in which you dwell, exists merely in my mind, is but a state of my consciousness, a part of my nature in which you are reflected, that gives you hospitality and that is the source of your existence. The annihilation with which you threaten me does not affect my argument, for you would be annihilated with me. It applies only to the individual, who is my

transitory vehicle and who, like everything else, is conceived by me in thought.

After further argumentation in the same strain, Schopenhauer makes the two shake hands and sing in unison to the effect that each is inseparably bound to the other, and that both are but the indispensable parts of a greater reality which comprises both and conditions their existence. The thorough-going spiritualist, however, like the early materialist, will put up with no compromise. Mind as we know it, or if not, something similar, an underlying entity, spirit, is the alpha and omega of existence, and all phenomena, physical and psychical, are manifestations of it; in the last resort all material objects can be deduced from the properties of mind or spirit.

This crude doctrine is now as much out of date as the crass materialism of the eighteenth century. But one valid argument

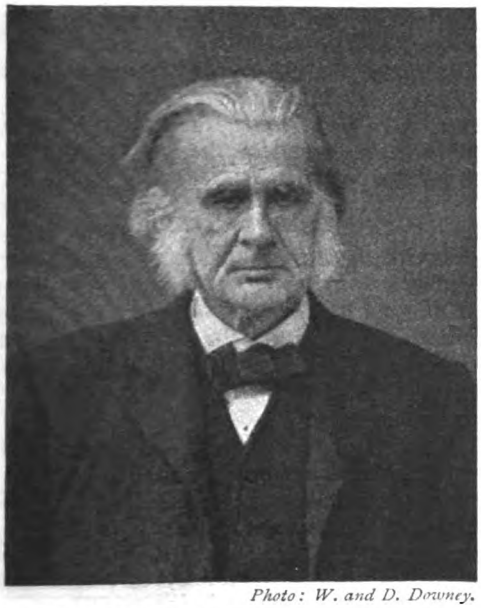

Photo: W. and D. Downey.

PROFESSOR T. H. HUXLEY (1825–1895).

remains: our knowledge of the world is that of our own states of consciousness. That this fact, from which it seems impossible to get away, does not necessarily preclude the existence of a world outside ourselves, a non-ego, will be shown in the Theory of Knowledge. It is sometimes urged by spiritualists that a valid and consistent materialism should show how mind has arisen or developed from matter. Materialists answer that a logical spiritualism must equally be able to demonstrate the origin and evolution of matter from mind. To the writer's mind, neither materialism nor spiritualism can make any such demonstration. Each contains the elements of truth, of error, and of speculation.

The materialist may very probably be right in his contentions; that matter has an existence *per se;* that it preceded mind in point of time; that mental phenomena only

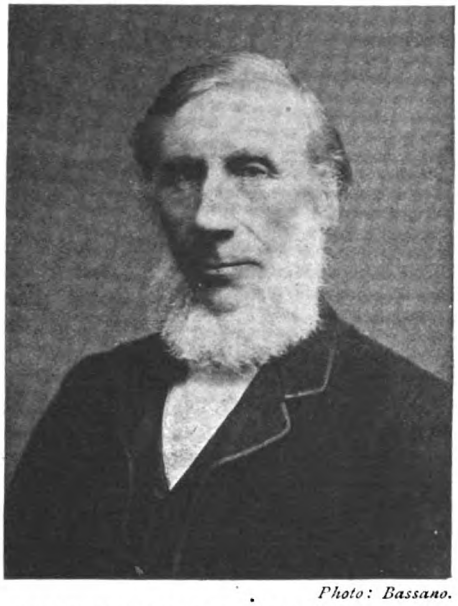

Photo: Bassano.

PROFESSOR JOHN TYNDALL (1820–1893).

occur concomitantly with material changes; but he has never yet shown how the phenomena of mind can be deduced by any process of logic from the phenomena of matter. The spiritualist is irrefutable when he contends that the external world is only known to us through our consciousness, but he may err in reading his own consciousness into all parts of that world.

Summary

The general upheaval against tradition and authority in the eighteenth century found an echo in a crude materialistic philosophy, which, *inter alia*, sought to explain all phenomena in terms of matter and motion.

Nineteenth century materialism drew sustenance from the important advances made by science. Büchner's "Force and Matter" profoundly influenced the trend of general thought.

In the latter half of the same century, Huxley, Tyndall, Dubois Raymond and others adopted an agnostic attitude towards the ontological problem.

Thorough-going spiritualism contends that all physical phenomena can be explained by deduction from the properties of mind or spirit.

The spiritualistic stronghold is the fact that all our knowledge of the outer world is the knowledge of our own mental states.

E. H. T.

Continued from Vol. III., page 454.

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THE PROTESTANT REVOLT IN SWITZERLAND

SWITZERLAND, one of the smallest of the independent states of Europe, was in early times occupied by several Gallic tribes. The largest and most important of these were the Helvetii and the Rhætii.

These tribes were first conquered by the Romans after a stubborn resistance. Subsequently they fell an easy prey to the Teutonic invaders of Western Europe—the Burgundians, Franks, and Alemanni.

The Alemanni were the first to carry devastation through the land. They were followed by the Burgundians, who, being Christians and on better terms with the Romans than had been the Alemanni, obtained some of the lands they occupied by treaty.

In what is now West Switzerland, they found a country possessed of some degree of civilisation, and soon became merged with those Romans who had remained. This combination resulted in the character of the Romance nations and also in the mongrel Latin tongue that still survives.

Early Swiss History

In Eastern and Central Switzerland, which were occupied by the Alemanni after they were driven from the west by the Burgundians, progress was at first slower owing to the character of the fierce Alemanni. The remnants of the Rhætii retreated to the hills, giving their name to the Rhætian Alps, and it is these Rhætians and their descendants who alone among the Eastern and Central Swiss retain their ancient Latin language.

After the Burgundians came another Teutonic tribe, the Franks, who conquered both the Burgundians and Alemanni. The Franks made no attempt to interfere with the ancient customs of their conquered subjects, and what is now Switzerland prospered as part of the Frankish Empire up to the death of Charlemagne (A.D. 814).

After the death of the great Charles, "Helvetia" suffered from internal disputes just as did the rest of the countries comprised in the Empire, and eventually came under the dominion of the family of Zaeringen, whose rule proved just and beneficent, and who were responsible for the building of Berne and Freibourg.

The rule of the Zaeringens came to an end in the year 1218. Then troubles began anew. The great lords, finding themselves practically independent, began violently to oppress the people.

William Tell

Powerful towns like Zurich and Berne managed to put up a resistance and defend their rights, but the smaller districts were helpless, and the death of the Emperor Rudolph of Hapsburg and the accession of his son Albert (1291) heralded bad times for the rural cantons.

Rudolph, on the whole, had been a good ruler. He had respected the privileges of the towns, and had even increased the rights of the inhabitants of the three forest districts or cantons of Uri, Schwytz and Unterwalden. His son, on the other hand, determined to reduce them all to submission. The towns again offered a stern resistance, but the three Forest Cantons, being powerless to resist, were cruelly oppressed by his bailiffs. Among the latter was the notorious Gessler, who made the famous if legendary William Tell shoot at the apple balanced on his son's head.

Whatever truth there may be in the stories concerning William Tell, there seems to be little doubt of the existence of the brave men who met together at this time on the shore of the Lake Uri, and swore solemnly to do away with the tyranny under which they groaned, or to perish in the attempt. The date of the first meeting of Stauffacher

of Schwyz, Furst of Uri, and Erni von Holden of Unterwald—as the names go—is given as November 7th, 1307. The meeting, however, but emphasised the "Everlasting League" made between the three cantons in 1291.

In 1315 was fought the famous battle of Morgarten—the Swiss Thermopylæ—at which the army of Leopold, brother of Rudolph of Hapsburg, was practically annihilated. This battle clinched the union of the three cantons, and in 1332 the League was strengthened by the addition of Lucerne, whose lake was thenceforth known as the *Vierwaldstätterzee.*

The importance of the entry of Lucerne into the League lay in the fact of its including a town, and so forming a precedent for future events. In 1351 the important town of Zurich joined the League, which was further greatly strengthened by the entry of Berne in the following year. At about the same time Glarus and Zug were also willingly "annexed"; and these eight cantons, differing in many respects one from another, formed, as they still form, the backbone of the republic of Switzerland.

It was at the battle of Laupen in 1339—when the men of Berne under von Bubenburg defeated an army of fifteen thousand men brought against them by the Burgundian nobles—that six thousand men from the Forest Cantons bore the famous red cross, which afterwards became the distinctive federal coat of arms.

The battles of Sempach (1386) and Naefels (1388) followed on in quick succession, and, though the gallantry of Arnold von Winkelried at Sempach has tended to throw the later battle into the shade, it is Naefels that is best remembered and still commemorated by the Swiss people on the first Thursday in April.

These two victories assured the independence of the republic. But troublous times were still to be endured before peace and a stable union were finally achieved.

Encouraged by their success, the cantons looked beyond their borders and began to attack the Emperor's hereditary possessions. Strife also began within. Zurich deserted her allies and joined Austria, and being besieged by the Confederates was only relieved by the Emperor calling in reinforcements consisting of French mercenaries.

From an old engraving. By permission of Messrs. T. H. Parker Bros.

WILLIAM TELL,

the legendary Swiss hero, who (circ. 1273) for failing to salute the Austrian governor, Gessler, was compelled to shoot with an arrow an apple placed on the head of his son.

Later Louis the Dauphin, subsequently known as Louis XI., entered the cantons at the head of 40,000 men, and having crushed all resistance, made peace with the Swiss—as they already were called—and declared that it was his wish to cultivate the friendship of so brave a nation.

One good result of the battle of St. Jacques,

which was a fitting end to the gallant resistance of the League, was the return to the fold of Zurich, for at this time the Confederation needed all its strength, being confronted by the most strenuous of all its struggles for existence. Charles the Bold, Duke of Burgundy, wishing to revive the ancient kingdom of Lorraine, and so form a great central European power stretching from the North Sea to the Mediterranean, naturally determined to include therein the Swiss Confederation. To this he was probably urged by his crafty opponent, Louis of France, who used all his powers to incense the Swiss against Charles, the Emperor also calling upon them to do their part against the common enemy.

Defeat of Charles the Bold

The war soon started, and after the men of Berne had made some successful inroads into Vaud and seized Lower Valais, Charles set out to chastise the Swiss with a large and well trained army. After easily recovering Vaud, he encountered the main army of Swiss, smaller than his own by a half, and owing to an error of strategy, was utterly defeated, his camp with all its belongings falling into the possession of the victorious Swiss.

A second battle at Morat, fought on the anniversary of Laupen, finally crushed the hopes of Charles, and the next year he met his death at Nancy (1477).

Swiss Independence

One more struggle had still to be maintained against the Emperor Maximilian, and when that ended successfully the freedom of the Confederation was finally secured by the Treaty of Basle, 1499. The Emperor then yielded to the Swiss their unconditional independence as a nation.

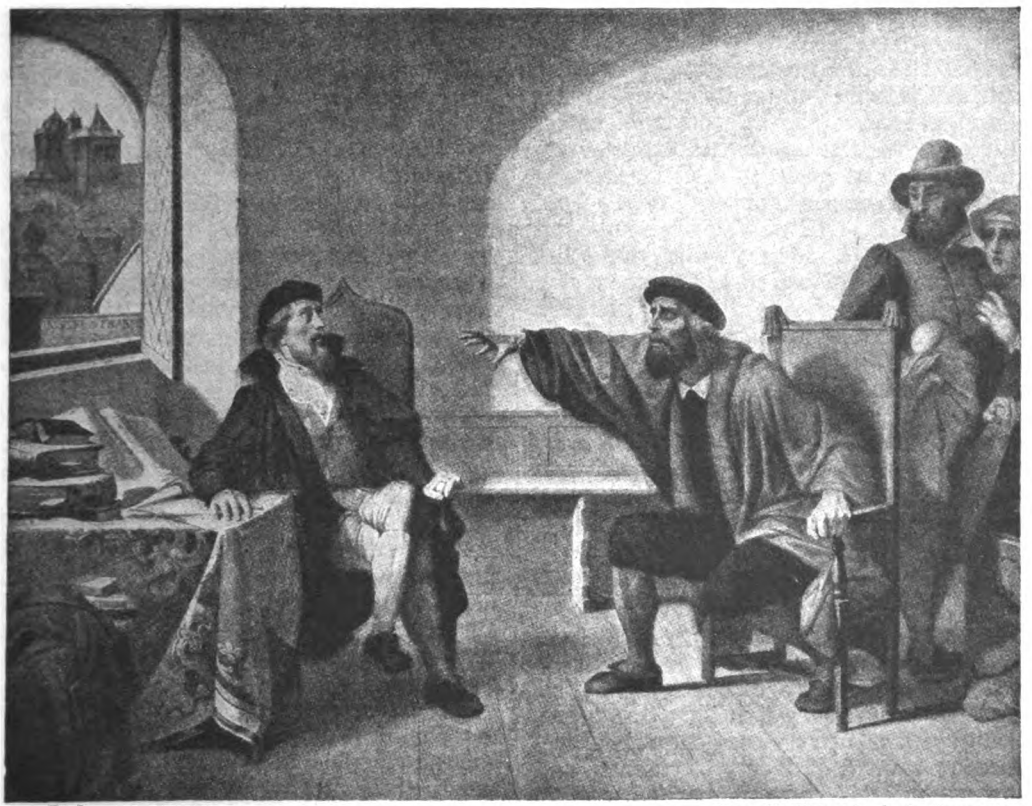
Immediately after this treaty, in 1501, Basle petitioned to join the League. Schaffhausen followed, and Appenzell in a few years later. Freibourg and Soluthurn had already become members at the Diet of Stanz in 1481. The leagued States, therefore, now numbered thirteen, and at this they remained for three centuries.

The one common tie that bound together these thirteen States was the Diet, or Tagsatzung, which met at one of the chief towns, Zurich, Lucerne, Berne or Basle. Each

From the picture by Labouchere.

JOHN CALVIN

addressing a Council at Geneva, where the reformer finally settled in 1541 and acquired so much influence that the town became known as the "Rome of Calvinism."



From the picture by J. L. Burgardon.

WILLIAM FAREL,

the indefatigable French missionary, trying to dissuade John Calvin, the yet more famous French reformer, from leaving Geneva.

canton had one representative, and each representative one equal vote—an arrangement that seemed very unfair to the democratic mind of Zwingli, the towns being much more populous than the country cantons.

All things considered, the administration of the Diet proved remarkably efficient. Apart from its control the cantons formed so many independent States. The towns mostly were governed by councils, generally oligarchies of ruling families. Zurich, however, was comparatively democratic. The chief magistrate at Basle, Zurich and Schaffhausen had the title of Burgomaster, while at Berne, Soluthurn, Lucerne and Freibourg he was called *Avoyer*, or *Schultheiss*. In the country cantons of Schwyz, Uri, Unterwald, Zug, Glarus and Appenzell he was called *Landammann*.

Pure Democracy

These country States were really pure democracies. At their open-air assemblies, or *Landsgemeinden*, they elected a council to attend to the necessary business of the community, but all power given was merely a delegation from the people.

From this it may be gathered that the Confederation was of a kind loose in the extreme, and, on account of this, the young republic had many difficulties to encounter and overcome.

Ulrich Zwingli

On the 1st January, 1484, was born in the Toggenburg one Ulrich Zwingli.

Born a few weeks after Martin Luther, in very different surroundings, it is claimed by his followers that he was fully a year before Luther in declaring against what he considered the abuses of the Church of Rome. After studying classics at Basle he was appointed first curé of Glarus in 1506, and, after officiating as chaplain to the Swiss mercenaries of the canton in their expeditions to Italy, he went to Einsiedeln for a few years.

Here he was brought in contact with the pilgrims who came to visit the shrine of the Black Virgin; and he soon began to

denounce the whole idea of pilgrimage as unscriptural and futile.

In 1518 he took up the position of preacher in Zurich Cathedral, where he at once began to inveigh against the sale of indulgences, and induced the Council of Zurich to prevent a priest who had been engaged in carrying on this trade in the Forest Cantons from entering Zurich. He was also instrumental in keeping Zurich from joining the other cantons in their alliance with France, saying that, although it was no sin to eat meat on a fast day, it was a great sin to sell flesh for the slaughter.

In 1520 Zwingli resigned his pension from the Pope and was soon engaged in defending his contention that fasting was merely a human ordinance. The Council of Zurich sided with Zwingli, who then proceeded to attack the rule prescribing the celibacy of the clergy.

Progress of Reform

A conference was fixed to take place at Zurich in 1523. This was duly held, and the Reformer produced his sixty-seven theses which he supported so convincingly by his arguments that he was held to have prevailed over the Pope's vicar-general, Faber.

Already several of Zwingli's friends and followers—priests—had got married, and in 1524 he himself publicly married Anna Reinhardt, a widow. From that time marriage became the rule among the reformed clergy.

In the same year pictures and other ornaments began to disappear from the churches. Monasteries were turned into almshouses. Mass ceased to be said in Zurich; while out of the new revenues was erected a school for theologians, where many eminent men were teachers.

Meanwhile the new doctrines were spreading in many of the smaller districts, and Zwingli was considering the question of forming a Protestant League. Before doing so, however, he thought it advisable to win over more definitely the important town of Berne, where already many Reformers were to be found. Accordingly he challenged his adversaries to a public discussion.

This began on the 18th January, 1528, and lasted eighteen days. No fewer than 350 ecclesiastics from the various cantons came to hear the pleadings. The result was that Berne was completely won over to Reform.

The Reformers were now numerous in Basle and Schaffhausen as well as Berne, and were also to be found in Glarus, Appenzell and the Grisons. The Forest Cantons, however, with Lucerne and Zug, were staunchly Catholic, as also were many of the smaller rural districts. These now formed a league for the defence of the Catholic faith.

To counteract this league, Zurich and Berne formed an alliance, and feelings began to grow more bitter. A Protestant minister was burned at Schwytz, a landammann of Unterwald publicly executed at Zurich, and war between the two parties became an unhappy certainty. It was deferred, however, for a time, the first hostilities being brought to an end by the famous *milchsuppe* truce, when the Catholics produced a bowl of milk and the Zurichers some rolls, and the two sides supped together instead of shedding each other's blood.

Unhappily this reasonable method of mutual tolerance lasted a very short time. Passions were aroused, and the sword became once more the final arbiter.

For in 1531, exasperated by the act—for which Berne was chiefly responsible—of the Protestants in refusing to trade with them, the Forest Cantons attacked Zurich. The Zurichers were utterly defeated, and Zwingli himself fell a victim to the fury of a mercenary.

The victorious Catholics, after holding a court martial over the body of Zwingli the next day, ordered it to be publicly burnt, and the ashes to be mixed with rubbish and scattered to the winds. "Such was the end of Ulrich Zwingli, the great Reformer of Switzerland, a man single-hearted, pious and disinterested . . . . as free as the times allowed from any violence or fanaticism and still more from inhumanity towards his antagonists."

John Calvin

The Catholics followed up this victory by defeating the men of Berne. A peace was then made by which liberty of conscience was granted to both sides, Zurich agreeing to pay the costs of the war.

But the Swiss Reformation did not die out with its founder. In 1532 that indefatigable French missionary, William Farel, came to Geneva, and later persuaded a yet more famous Frenchman, John Calvin, to take up his abode in that same city.

Calvin, however, had soon to quit Geneva owing to the opposition of the Catholic party and the "libertines"; in 1541 he returned, and proceeded to set up his "theocratic government," Geneva becoming known as the "Rome of Calvinism." His views—narrower than those of Zwingli—finally prevailed; and Calvin rather than Luther or Zwingli may be regarded as the founder of the Protestant Churches in Holland, France, England and Scotland.

F. C.

Continued from Vol. III., page 476.

SCIENCES:

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CHEMISTRY.—XXV

The Metals—Sodium Calcium, Iron.—The elements may be roughly divided into two classes, metals and non-metals. With few exceptions the metals are dense, lustrous and malleable solids, possessing high melting and boiling points, and conducting heat and electricity well. On the other hand, many of the non-metals are gases, one only—bromine—is a liquid, and a few are solid at the ordinary temperature. The solid non-metals are mostly light, have no pronounced lustre, usually melt at a comparatively low temperature, and are bad conductors of heat and electricity.

This classification is by no means rigid, and the exceptions are many. Thus sodium and potassium are lighter than water, and melt easily; iodine is heavy (sp. gr. 4·9) and lustrous; gas carbon is a good conductor; and arsenic has properties which would admit of its inclusion in either class. Perhaps the best criterion is afforded by the distinction that the electrical conductivity of metals diminishes as the temperature rises, whilst that of solid non-metals increases. In regard to chemical properties, the metals do not combine with hydrogen, but unite readily with oxygen, and their lower oxides are basic; the non-metals combine readily with hydrogen, and their oxides are mostly acidic. The student should be able to adduce illustrations of all the above-mentioned facts for himself.

Sodium.—Sodium is one of the most active elements, and hence it never occurs free in nature. The chief minerals containing it are common salt or rock salt, and Chili saltpetre. Sir H. Davy was the first to isolate it (1807) by a method which is used to-day on the industrial scale, viz. by the electrolysis of molten caustic soda, $2NaOH=2Na+H_2+O_2$. The metal and hydrogen separate at the cathode, and the oxygen at the anode. Sodium chloride is less suited for this purpose owing to its high melting point, $2NaCl=2Na+Cl_2$. Commercial sodium is mostly converted into cyanide, NaCN, for use in gold extraction; some of it is converted into sodium peroxide, and some is used in making organic compounds, e.g. antinyrine. A fresh surface of this metal shows high lustre and a silver-white colour. It is very soft, has a sp. gr. of 0·974, melts at 97°, and boils at 742°—producing a violet vapour. The molecule of sodium vapour is monatomic. As we have already performed several experiments with this metal, it will be unnecessary to detail its chemical properties, suffice it to say that it is exceedingly energetic and is a strong reducing agent.

Oxides.—Sodium forms two oxides, $Na_2O+Na_2O_2$. The former is of little importance, but its behaviour towards water should be noted; it combines with it to form the alkali, sodium hydroxide, $Na_2O+H_2O=2NaOH$. The peroxide, Na_2O_2, is made commercially by burning the metal at 400° in shallow aluminium vessels, a current of air freed from carbon dioxide and moisture being passed over it. It is a light yellow powder, with strong oxidising properties. With water it yields caustic soda and oxygen, and with cold dilute hydrochloric acid, the well known oxidising and bleaching agent, hydrogen peroxide, H_2O_2, is produced, $Na_2O_2+2HCl=H_2O_2+2NaCl$.

Hydroxide.—Sodium hydroxide or caustic soda, NaOH, is one of the most valuable chemicals, being used in enormous quantities in the manufacture of soap and paper. A modern method of preparation consists in electrolysing a solution of common salt with a carbon anode and a mercury cathode. The separated sodium amalgamates with the mercury, the amalgam is treated with water in a separate chamber, and the mercury is recovered and used again (the student should give the equations). Caustic soda is a white solid, strongly alkaline, caustic, and very deliquescent. When heated to 320° it melts, but remains undecomposed even at far higher temperatures. It is a typical alkali, i.e. a soluble basic hydroxide, and by neutralising it with acids a large number of salts can be prepared. As the more important of these salts have already been described, they will not be considered again in this place. A few words, however, may be devoted to the manufacture of those very important substances, soda, i.e. soda ash, Na_2CO_3, washing soda, $Na_2CO_3.10H_2O$, and sodium bicarbonate, $NaHCO_3$.

In the Leblanc soda process, salt is heated with sulphuric acid: $2NaCl + H_2SO_4 = 2HCl + Na_2SO_4$, the hydrogen chloride is collected in water, and the sodium sulphate, or "salt cake" is strongly heated with ground limestone and coal, $Na_2SO_4 + CaCO_3 + 4C = Na_2CO_3 + CaS + 4CO$. The soluble carbonate is then leached out with water and crystallised. Soda ash is obtained by calcining it.

Bicarbonate can be made by heating it in a current of carbon dioxide. In the Solvay process cooled brine is saturated with ammonia and carbon dioxide gases, $NaCl + H_2CO_3 + NH_3 = NaHCO_3 + NH_4Cl$. On crystallising the bicarbonate separates, leaving the more soluble ammonium chloride in the mother liquor. The ammonia is recovered by heating the latter with lime or magnesia (MgO). Bicarbonate is converted into soda ash by heating, as previously described.

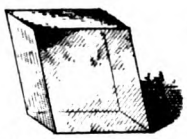


Fig. 42.—Iceland Spar (crystallised calcium carbonate).

Calcium. — This metal belongs to the so-called alkaline earth group which includes strontium and barium. The oxides of these three metals are all earthly substances and form alkalis with water. Calcium is found abundantly in nature, especially as the carbonate, sulphate and phosphate. It is isolated by the electrolysis of the fused chloride, $CaCl_2 = Ca + Cl_2$, and so obtained is a white, lustrous, somewhat brittle metal of sp. gr. 1·55. Although energetic, it is less active than sodium, decomposing water slowly to form calcium hydroxide and hydrogen, $Ca + 2H_2O = Ca(OH)_2 + H_2$. It tarnishes in the air, and when heated burns to form quicklime, CaO; at the same time some of it unites with atmospheric nitrogen to yield calcium nitride, Ca_3N_2.

Calcium oxide is made by igniting the carbonate, preferably marble. It is a white, amorphous, basic substance which combines with water to form slaked lime, much heat being evolved in the process, $CaO + H_2O = Ca(OH)_2$. It is one of the most refractory substances known; but it melts in the electric furnace at above 3000°; far below this temperature it becomes incandescent, i.e. emits a bright light without undergoing any chemical change. Quicklime is extensively used for making mortar and cements, carbide, bleaching powder, glass, as a fertiliser, as a flux in metallurgy, and for purifying coal gas, etc.

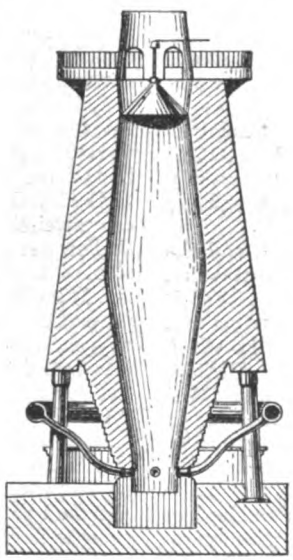


Fig. 43.—BLAST FURNACE.

Consists of a high vertical shaft somewhat widened below the middle and supplied with inlets for hot air near the base.

Calcium hydroxide or slaked lime is a soft, white amorphous powder, dissolving in water (0·17 grms. in 100 at 10°) to form an alkaline liquid called "lime-water." "Milk of lime" is made by mixing an excess of lime with water; it contains both dissolved and suspended calcium hydroxide. At a high temperature it is decomposed, $Ca(OH)_2 = CaO + H_2O$. The chemistry of the carbonate, phosphate and carbide has already been discussed, but the naturally occurring forms of the first-named need enumeration. Crystallised calcium carbonate is found as Iceland spar (the purest form), calcite, marble, and in another crystalline form as arragonite; in the amorphous state it occurs as chalk, limestone, stalactites and stalagmites, and it forms the main constituent of the shells of land and sea animals.

Calcium chloride and *Calcium nitrate* are two very soluble salts best made by dissolving the carbonate in the corresponding acid. They are both white and very deliquescent. The chloride is much used as a drying agent, both in the granular form and in white hard lumps as "fused" calcium chloride. Calcium nitrate is found in fertile soils.

Calcium sulphate occurs in nature as gypsum, $CaSO_4 \cdot 2H_2O$, and as anhydrite, $CaSO_4$. Owing to its very low solubility in water (about 0·2 in 100 grms.) it can be prepared by precipitation. The addition of any soluble sulphate to the solution of a calcium salt causes it to separate as a white powder, $CaCl_2 + Na_2SO_4 = CaSO_4 + 2NaCl$. The presence of this salt, and also that of magnesium sulphate, is the cause of the permanent hardness of a natural water. When gypsum is heated to 130°, it loses two-thirds of its water of crystallisation and is converted into "plaster of Paris," $2CaSO_4 \cdot H_2O$, a white powder which when moistened soon sets to a hard mass, owing to the re-formation of gypsum.

Iron. — Iron is probably the most useful of all metals, and, after aluminium, occurs the most abundantly. Free iron is found only in meteoric masses, though the central core of the earth is believed to consist of it. The chief minerals are: red hæmatite, Fe_2O_3, magnetite, Fe_3O_4, iron pyrites, FeS_2, but there are many others.

The commercial forms of this metal are called cast or pig iron, steel, and wrought or malleable iron.

Cast Iron contains most carbon (2·2-4·5 per cent., also Si, S, P, and Mn). It has the lowest melting point of the three forms: it is brittle, and its tensile strength is low.

Steel contains about 1 per cent. carbon; its melting point is intermediate between those of cast iron and steel: it is malleable and ductile, and has a high tensile strength.

Wrought Iron contains least carbon (very little S and P); it has the highest melting point: is malleable and ductile, and its tensile strength lies between those of cast iron and steel.

Cast iron is manufactured by (i) heating the native oxide or carbonate ore to expel water and

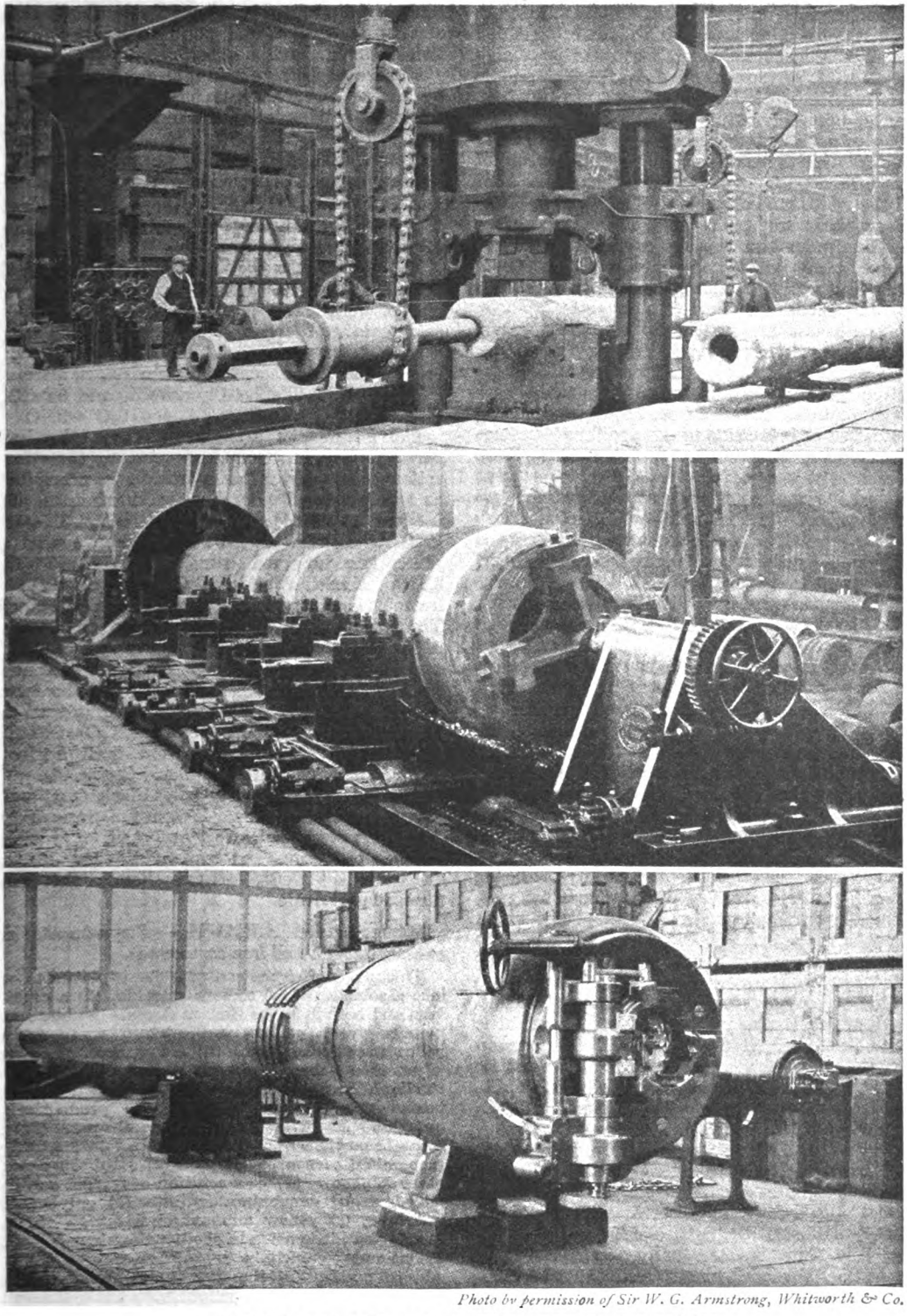


Photo by permission of Sir W. G. Armstrong, Whitworth & Co.

THREE STAGES IN A BIG GUN'S GROWTH.

The top photograph shows the white-hot ingot being roughly shaped in a hydraulic press; the centre photograph shows the roughly shaped ingot being worked upon by eight cutting tools. At the bottom the finished "piece" is seen in the examination shop, awaiting tests.

carbon dioxide to make it porous, and (ii) reducing it in a blast furnace with coke, limestone being added as a flux. The blast furnace consists of a high vertical shaft somewhat widened below the middle and supplied with inlets for hot air (*tuyères*) near the base (Fig. 43).

The actual reduction is effected by the carbon monoxide which results from the interaction of carbon dioxide, due to the combustion of the fuel, and the white hot coke, $Fe_2O_3+3CO=2Fe+3CO_2$. The reduced iron takes up carbon and melts; the silica present in the ore unites with lime to form an easily fusible calcium silicate or "slag," which floats on the molten iron collected at the base and is run out through a separate tap-hole. The iron is cast into moulds shaped something like a pig's back, and hence the name "pig" iron. The waste gases issuing from the top are utilised for heating the air that enters through the *tuyères*.

Wrought iron is obtained from cast iron by melting it on a bed of iron oxide in a "puddling" furnace in a current of air, and stirring or "puddling" the mass until it becomes pasty. By this treatment most of the carbon, phosphorus and sulphur are burnt out, and other impurities combine with iron oxide to form slag; the latter is removed from the pasty metal by squeezing it under a steam hammer. The wrought iron is finally rolled.

Steel is made by several different processes. The Bessemer process consists in blowing air through molten pig iron contained in a "converter," an egg-shaped furnace mounted centrally on pivots and lined internally with calcined dolomite (CaO and MgO). In this way carbon and sulphur are oxidised, and the phosphorus combines with the lime to form phosphate—the valuable product "basic slag" (one of the most efficient fertilisers). Ferro-manganese—an alloy of iron, manganese and carbon—is then added, the converter is turned over and the molten steel run into moulds. The hardness of steel is varied by cooling it slowly or suddenly.

Pure iron can be obtained by reducing an oxide in hydrogen at 500-600°. It is grey, lustrous, tough, malleable and ductile, has a sp. gr. of 7·8, and is strongly magnetic. Exposed to moisture and carbon dioxide, it becomes coated with "rust," a hydrated ferric oxide. It burns in air and in oxygen, forming the magnetic oxide, Fe_3O_4, which is also produced when the metal is heated in steam. It dissolves in all the common acids, but not in alkalis. Iron exhibits two valencies: in the ferrous compounds, e.g. FeO and $FeCl_2$, it is divalent; in the ferric compounds, e.g. Fe_2O_3 and $FeCl_3$, it is trivalent.

Ferrous Oxide, FeO, is comparatively unimportant, but *Ferrous Hydroxide* is of more interest as it is readily precipitated from ferrous salts by adding alkalis, and because it dissolves easily in acids. $FeSO_4+2NH_4OH=Fe(OH)_2+(NH_4)_2SO_4$. When pure, it is white, but as usually obtained it has a dirty greenish colour owing to incipient oxidations.

Ferrous chloride is obtained as glistening yellowish-white crystals by heating iron in hydrogen chloride. The hydrated form, $FeCl_2$, $4H_2O$, made by dissolving the metal in hydrochloric acid and crystallising, consists of bluish green crystals.

Ferrous sulphate, $FeSO_4$, $7H_2O$, is an important commercial product, being used in the manufacture of Prussian blue, of iron gall inks, in the purification of sewage, and as a mordant in dyeing.

Ferrous sulphide is obtained as a black precipitate by adding an alkaline sulphide, e.g. ammonium sulphide, to the solution of a ferrous salt, $FeSO_4+(NH_4)_2S=FeS+(NH_4)_2SO_4$. It dissolves readily in dilute acids, and hence is not precipitated by passing hydrogen sulphide into a ferrous salt solution, $FeSO_4+H_2S\rightleftarrows FeS+H_2SO_4$. The usual mode of preparation is by heating a mixture of iron and sulphur in a closed vessel.

The ferrous salts are usually light greenish-blue when hydrated, but become white when their water of crystallisation is expelled. They are unstable, being oxidised to ferric salts on exposure. The conversion, however, is much more readily effected by using an oxidising agent, e.g. chlorine, or nitric and sulphuric acids, $2FeCl_2+Cl_2=2FeCl_3$ and $6FeSO_4+3H_2SO_4+2HNO_3=3Fe_2(SO_4)_3+4H_2O+2NO$.

The ferric salts are derived from the bases, *Ferric Oxide* and *Ferric Hydroxide*, by their interaction with acids. The hydroxide is precipitated as a brownish-red amorphous solid when an alkali is added to a ferric salt solution, $FeCl_3+3NaOH=Fe(OH)_3+3NaCl$. It loses water when heated and yields the dark red oxide, $2Fe(OH)_3=Fe_2O_3+3H_2O$. *Ferric chloride*, $FeCl_3$, is obtained as lustrous, black crystals by heating iron in chlorine. The hydrated substance is yellow and deliquescent. All the ferric salts are fairly readily reduced to the corresponding ferrous salts. Thus in presence of zinc and acid, ferric chloride is reduced to ferrous chloride, $FeCl_3+H=FeCl_2+H$. Sulphurous acid is equally potent, $2FeCl_3+H_2SO_3+H_2O=2FeCl_2+2HCl+H_2SO_4$; and the reaction with hydrogen sulphide is $2FeCl_3+H_2S=2FeCl_2+S+2HCl$.

Magnetic iron oxide, Fe_3O_4, is black and, as the name implies, magnetic. It is not a basic oxide; when dissolved in hydrochloric acid it yields a mixture of ferrous and ferric chlorides, $Fe_3O_4+8HCl=FeCl_2+2FeCl_3+4H_2O$; hence the name ferroso-ferric oxide.

Experiment LXXVII. — *Experiments with sodium, calcium and iron compounds.*

(i) Dip a loop at the end of a clean platinum wire into a solution of (*a*) sodium chloride, (*b*) a calcium salt, and hold it in the Bunsen flame. Sodium compounds give a yellow, and calcium compounds a yellowish-red coloration. (ii) A fragment of calcium is put into water; hydrogen is evolved slowly, and the liquid becomes turbid. (iii) Another fragment is heated strongly on porcelain; the production of quicklime should be noted, and confirmed. (iv) To separate portions of calcium chloride solution add (*a*) ammonium carbonate solution, (*b*) sulphuric acid or other sulphate. (v) To a solution of ferrous sulphate introduce (*a*) ammonium hydrate, (*b*) sulphuretted hydrogen, (*c*) yellow ammonium sulphide, (*d*) sulphuric and nitric acids in small amounts; when the oxidation is complete, note the change in colour, and add to portions of the new liquid (*e*) ammonium hydrate, (*f*) hydrogen sulphide, and (*g*) sulphur dioxide; in the last case confirm the reduction by testing with an alkali.

With this short sketch of three common metals we must bring our introduction to Inorganic Chemistry to a close. E. H. T.

ELECTRICITY AND MAGNETISM XIII

Arrangement of Conductors and Resistance.—Our experiments have shown us that the total resistance of a circuit depends upon the construction of the cell, or generating apparatus, and upon the length, thickness and material of which the conducting wires of the external portion of the circuit is composed. There is another factor. The external circuit may not consist of a simple wire, but may be a more complex arrangement of conducting wires in which the current may have more than one path available. In actual practical applications this is often the case, and we must now consider the resistance of the external circuit when its conducting wires are arranged in different ways.

Experiment 39.—*To note the galvanometer deflexion when two similar wires are connected in Series.*

Set the tangent galvanometer in the magnetic meridian, and by means of a short copper wire connect one end of the copper circle with either terminal of a dry cell. Take two pieces of iron wire, each one yard long and having the same thickness. Connect the end of one wire firmly to an end of the other by twisting them together. You have now about two yards of iron wire. Wires connected in this way, one after another, are said to be connected in *Series*. Fasten one end of the iron wire to the other end of the galvanometer without disturbing the instrument. The two-yard piece of iron wire has now a free end, which should be pressed against the other terminal of the cell when you are ready to note the reading of the galvanometer. Take the reading when needle is steady. If the student possesses an ammeter, he can use it in place of the tangent galvanometer, but he must be careful to send the current through the instrument in the right direction by connecting the positive plate of the cell to that terminal of the ammeter marked with a + sign. In this case the strength of the current in Ampères must be recorded.

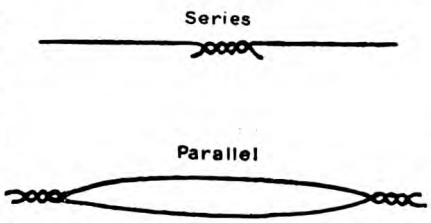


Fig. 45.—Experiment shows that with a given E.M.F. a better current is obtained when conductors are arranged in parallel than when they are joined up in series.

Experiment 40.—*To note the galvanometer deflexion when two similar wires are connected in Parallel.*

Use the same cell and galvanometer (or ammeter) employed in the previous experiment. Be careful to see that the galvanometer is still properly set in the meridian. Connect the two one-yard pieces of iron together side by side by twisting the ends at both extremities. Do not let the two wires come in contact except at the twisted ends. Wires connected in this way, side by side, are said to be arranged in *Parallel*. Fasten one extremity of the parallel wires to the tangent galvanometer, and press the free end against the other terminal of the cell. Note the deflexion of the galvanometer. Compare the tangents of the angles obtained in this and the previous experiment. The currents will be proportional to the respective tangents.

The results of our experiments show that with a given E.M.F. a better current is obtained when conductors are arranged in parallel than when they are joined up in series. The parallel arrangement presents more than one pathway for the current to traverse, hence the resistance of the circuit is less.

Experiment 41.—*To note the galvanometer deflexion when only one yard piece of the iron wire is used.*

Fit up the apparatus as in the previous experiment but use only one of the yard pieces of iron wire. Compare the tangent of the angle of deflexion with that obtained in Experiment 40.

From this experiment we obtain the important result that with wires of the same material, length and thickness, the current strength is less when a single strand of wire is used than it is when two wires are used in *parallel*.

The student should perform similar experiments with pieces of wire made of different materials, say copper and iron. Compare the tangents obtained when

(1) A yard of iron wire is connected with a yard of copper wire in series, then in parallel.

(2) Wires of unequal thickness are joined up in series and in parallel.

(3) Several similar or dissimilar wires are connected in parallel.

In performing these experiments we must be careful to see that the current from the cell flows only when we are taking the reading of the galvanometer deflexion, otherwise the voltage of the cell may change during the experiments. Should this happen the resulting current will be modified and our conclusions concerning resistance will be incorrect.

The truth of Ohm's Law must always be borne in mind. The strength of a current in any circuit will depend upon the resistance of that circuit as a whole and the Electro-Motive-Force that is sending the current around the circuit.

The resistance of some circuits is high, and if a current of any practical value is to be obtained the E.M.F. of the generating apparatus must be sufficiently great. Suppose that you wish to fit up a bell in a workshop so that someone may summon you from your house which may be at the other end of a long garden. The circuit will be composed of many yards of wire, and the voltage of a single Leclanché or dry cell may be insufficient to overcome the resistance of the wires. The current obtained will then be too feeble to ring the bell. You will naturally assume that more than one cell should be used, *and in such a way that the voltage of one may be added to that of the other.* How is this to be done?

Experiments on Electro-Motive-Force.—By noting various deflexions of the galvanometer needle we can make comparisons of the strengths of various currents. If the E.M.F. at our disposal remains constant, then variations in current must be due to differences in resistance of the circuit, and

similarly if the resistance remains unchangeable variations of the current must be the result of alterations in Electro-Motive-Force.

We are about to perform experiments in which the E.M.F. is varied, but the resistance of the circuit kept as constant as possible. It will not be possible to keep the total resistance quite constant since each cell has its own internal resistance. This will not be a very serious matter if we arrange the apparatus so that the resistance of the external portion of the circuit is great in comparison with the internal resistance of the cells employed in the

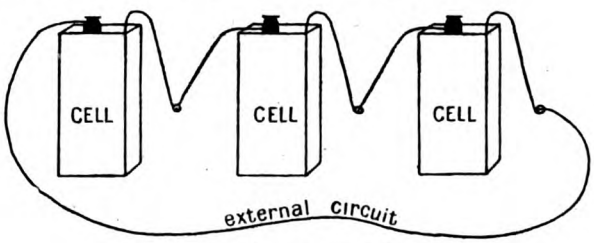


Fig. 46.—Cells arranged in series.

experiments. In testing E.M.F., or voltage as its measure is usually termed, the E.M.F. is made to send a current along a circuit of high resistance, consequently the greater the E.M.F. the stronger the resulting current. Voltmeters, the instruments used for the direct measurement of E.M.F., are based upon this principle.

Experiment 42.—*To arrange cells so that the E.M.F. of the arrangement is greater than that of a single cell.*

Set the tangent galvanometer in the magnetic meridian and attach to one end of the copper circle a conductor of high resistance. This can be made of four or five yards of thin iron wire wound around a wooden block in such a way that the turns of wire do not touch one another. The ends of the iron wire can be fastened in position by turning it around two small nails driven into the wood at the necessary

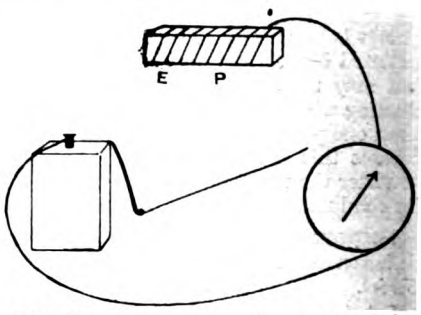
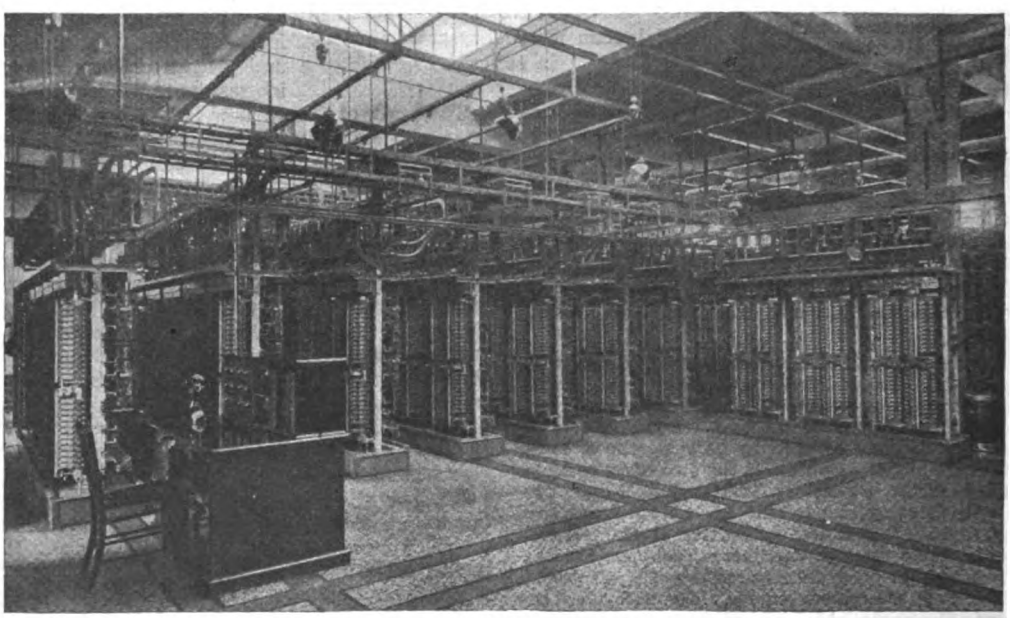


Fig. 47.—Arranging cells so that the E.M.F. of the arrangement is greater than that of a single cell.

positions. Connect the other end of the galvanometer circle with one terminal, say the positive, of one dry cell. To the other terminal attach about one yard of copper wire. There is now a free end to the copper wire. This can be attached to any one of the turns of wire on the wooden block (Fig. 47). First connect it to the end E of the resistance wire. If the galvanometer gives no deflexion the resistance is too great, so that another point of connection P should be tried. This will cut out some of the iron wire, the resistance of the external circuit will be a little less, and a deflexion of the galvanometer may



THE AUTOMATIC TELEPHONE EXCHANGE

has many and obvious advantages over the old hand exchange (*see opposite*), which, being dependent for its efficiency on an often much harassed operator, must admit to a large extent the factor of human error.

be obtained. The position of the point P should be such that only a slight deflexion of the needle is obtained when a single cell is supplying the current. Note the angle of deflexion and obtain its tangent from the list. Do not disturb the connection of the wires at P, but disconnect a terminal of the cell in order to connect up others.

Now connect a second cell to the first by fastening the wire attached to the zinc plate of one to the screw connected with the carbon plate of the other. Complete the circuit, note the deflexion, and tabulate results. Introduce a third cell by joining up in a similar manner, i.e. the zinc of one cell must be attached to the carbon of the next and so on. *Cells joined up in this way are said to be connected in Series* (Fig. 46).

You will have noticed that the current became stronger every time you added another cell, and since the external resistance is great, the improvement in the current is the consequence of an increase in E.M.F. Hence we observe that *when cells are connected in series, the current of one flows through the others, and the voltage of each cell will be added to the others joined in series with it.* Thus three cells each having an E.M.F. of 2 volts will form a battery having a voltage of 6 when they are connected in series.

We must not overlook the fact that when cells

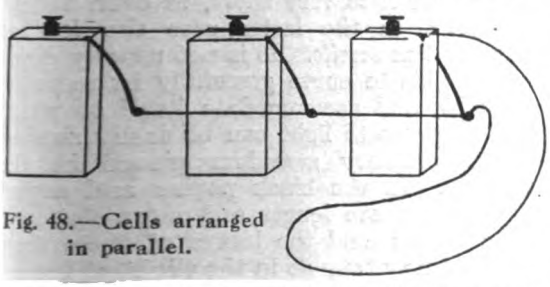


Fig. 48.—Cells arranged in parallel.

are joined in series not only is the voltage increased but the internal resistance is increased in like fashion. Three cells arranged in series will have three times the resistance of one cell. Hence the series arrangement of cells is the correct one when a high voltage is required to overcome an *external* circuit of considerable resistance. The lamps of the little flashlights that one buys from an electrician have a thin metallic filament which requires at least a 4-volt E.M.F. to overcome its resistance, hence the little dry batteries are composed of two or more dry cells arranged in Series.

In the case of the bell in the workshop at some distance from the house, two Leclanché cells or two dry cells should suffice to overcome the resistance of the circuit provided they are arranged in series.

Cells arranged in Parallel.—Now let us consider a second method of joining up cells.

Experiment 43.—*To arrange cells so that the E.M.F. of the arrangement is not greater than that of one cell.*

Retain the galvanometer, iron wire resistance and copper wire connected at the point P as they were in the previous experiment. As before, take the deflexion when one cell only is used. By means of wires connect two cells by uniting the two zinc wires together and the two carbon plates together. Complete the circuit and take the reading of the galvanometer. Compare this result with that obtained when two cells were joined in series. Add a third cell to the arrangement by connecting its zinc to the zincs of the other two and its carbon to the carbons of the others.

Complete the circuit and note the resulting deflexion. *Cells joined up in this way are said to be connected in Parallel* (Fig. 48).

In this case the current of one cell does not flow through any of the others, but joins the current flowing out of the others at the connecting wires. The E.M.F. is not increased. No matter how many cells of equal voltage may be connected in parallel the resulting voltage of the arrangement will be the same as that of one cell only.

But the internal resistance of the arrangement will be *reduced*, for joining cells in parallel is similar to enlarging the plates of a cell, and we have seen that the larger the plates the lower the resistance. Hence a parallel connection of cells is of use when the external portion of the circuit has a very low resistance.

When you have several cells at your disposal and you wish to obtain a good current along a

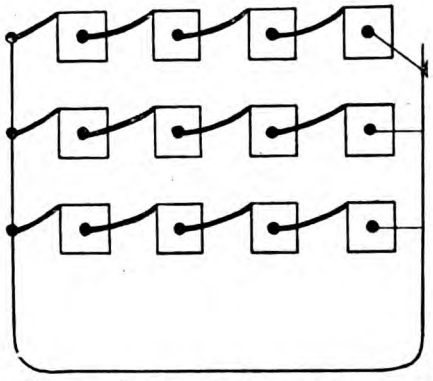


Fig. 49.—Twelve similar cells arranged in three rows, the rows being connected in parallel, the cells in series.

circuit of considerable though not really great resistance, it is well to join them partly in series and partly in parallel. Figure 49 shows twelve similar cells arranged in three rows, the rows themselves being connected in parallel, while the cells in each row are joined up in series.

Suppose the E.M.F. of each cell to be 2 volts, then the total E.M.F. of the twelve cells will be 8 volts, and the internal resistance will be much less than that of four cells in series. L. M. P.

BOTANY.—VII

18. The Shoot.—The shoot is that part of the plant which includes the stem and its various branches, the leaves and the flowers. It differs from the root in bearing buds, terminal and lateral, from which leaves or flowers may arise; a true shoot-branch arises in the leaf-axils: those which do not are known as *adventitious roots*, because they generally have root-functions. The shoot usually grows vertically upwards, i.e. is positively heliotropic and negatively geotropic; but it is often prostrate on account of its inability to support itself in the erect position; and sometimes it may be subterranean, forming a root-stock or *rhizome*.

Turning to the general functions of the stem, we see that it supports the leaves and raises them up towards the light, and conveys the current of soil-water or *sap* into the leaves. This latter function is carried out in a series of narrow tubes or *vessels*, which are the important constituents of the wood or its equivalent. These vessels spread out in the leaves and form their *veins*, which serve not only as sap carriers, but also make the skeletal framework of the leaf. The veins must thus be regarded as the limiting channels of the irrigation system of the plant.

19. The Leaf.—A typical leaf will show three distinct parts, represented diagrammatically in Fig. 40. We have (1) the *lamina* or blade; (2) the *petiole* or stalk; (3) the swollen *leaf-base:* to which we may add in a number of cases, (4) one or more *stipules*.

The lamina is commonly a broad, expanded structure, adapted to the purpose of catching as much light as possible. Sometimes it is long and narrow, or even insignificant. Whenever this is the case, we shall be able to discern some useful result to the plant. Thus the leaves of many plants that grow in meadows have long slender laminas; such leaves have a fair chance of growing among the grasses and sharing their light. Other leaves, like those of pines and firs, have reduced laminas in order, by diminishing the area exposed to the air, to reduce to a minimum the loss of water. Most leaf-shapes are, in fact, adapted to the plant's needs in some advantageous way.

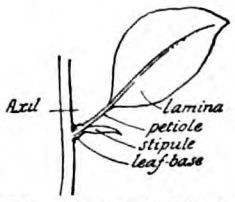


Fig. 40.—Typical leaf.

The petiole is, as a rule, a circular stalk, flattened and grooved on the upper side. Sometimes it is very short, or even absent entirely: in the latter case the leaf is described as *sessile*. It is not usually rigid, but is able to curve gracefully in response to light, and accommodate itself to wind. The response to light can be easily noticed in an ordinary geranium placed in the window. In the black poplar and aspen, the petioles are longer and more flattened than usual; and the leaves of these trees consequently tremble in the slightest breeze.

The leaf-bases are well marked in most leaves as small swollen cushions articulating with the stem. When the leaves fall off, a well-marked *leaf-scar* shows the position and the shape of the leaf-base.

Stipules, when present, generally take the form of one or two scaly structures arising at the base of the leaf. In the pea, however, the stipules are the most leafy part of the leaf. Two conspicuous stipules are characteristic parts of the leaf of the rose.

20. Veins, Shapes, and Margins of Leaves.—The shape of a leaf—that is, of the lamina—is determined by the veins, which are the only hard parts in the vast majority. The veins are either *reticulate* or *parallel* in their arrangement. The reticulate (or netted) type is usual in Dicotyledons. In this type we may have a strong main primary vein passing up the centre of the leaf, and giving off secondary veins as it proceeds. The secondary veins bear smaller branches, and those smaller ones still; the finer ones blending to form the network that can usually be seen plainly when a suitable leaf is examined on its under side. This method of veining, with one primary vein and several smaller secondaries, we speak of as *pinnate*. On the other hand, we may have no conspicuous midrib; the primaries then spread out fan-wise from the base of the lamina, and give off much smaller secondary veins as they proceed. This method we may call *palmate* (Fig. 41). The parallel type of venation is confined to Monocotyledons. Here the veins are few in number; they run lengthwise up the elongated leaf, and show very few cross-branches (Fig. 41).

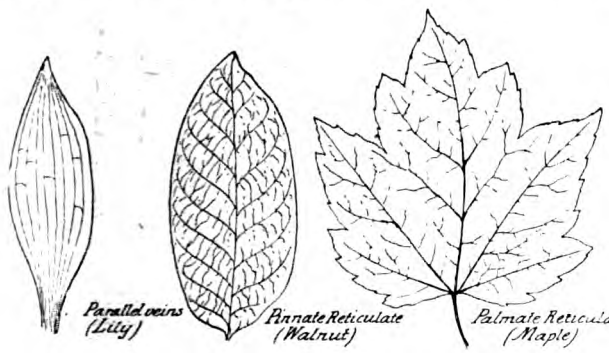


Fig. 41.—The shape of a leaf is determined by the veins, which may be parallel or reticulate.

The ends of the chief veins are generally prominent on the edge of the lamina, and thus fix both its shape and the nature of its margin and its apex. A number of technical terms are applied to these features by botanists: they are convenient as a sort of accurate shorthand, but we shall content ourselves with a few of the most common here.

A leaf is generally flat and two-sided, the under side being easily distinguishable by its lighter colour. Both these features are liable to exceptions; the *acicular* (needle-shaped) leaves of pines are, for example, circular, and, of course, not two-sided. Other leaves, like those of grasses, show very little difference between the upper and the under sides. It all depends on their light-habit: the leaf that exposes one side only to the light is greener on that side, for several reasons which we shall soon examine.

The commoner leaf shapes may be classified as follows:

1. Leaves broadest near the Base: *lanceolate* (lance-shaped); *ovate* (egg-shaped); *cordate* (heart-shaped); *sagittate* (arrowhead-shaped); *reniform* (kidney-shaped).

2. Leaves broadest near the Apex: *oblanceolate; obovate; obcordate; spathulate* (spoon-shaped).

3. Leaves broadest near the middle: *linear* (long and narrow); *elliptical; oval; circular* (or *orbicular*); *peltate* (shield-shaped: circular, with petiole attached to the middle of the lamina).

Sometimes the lobes of a leaf will partially wrap round the stalk (*amplexicaul*); or the stem will pass right through the lamina (*perfoliate*). When

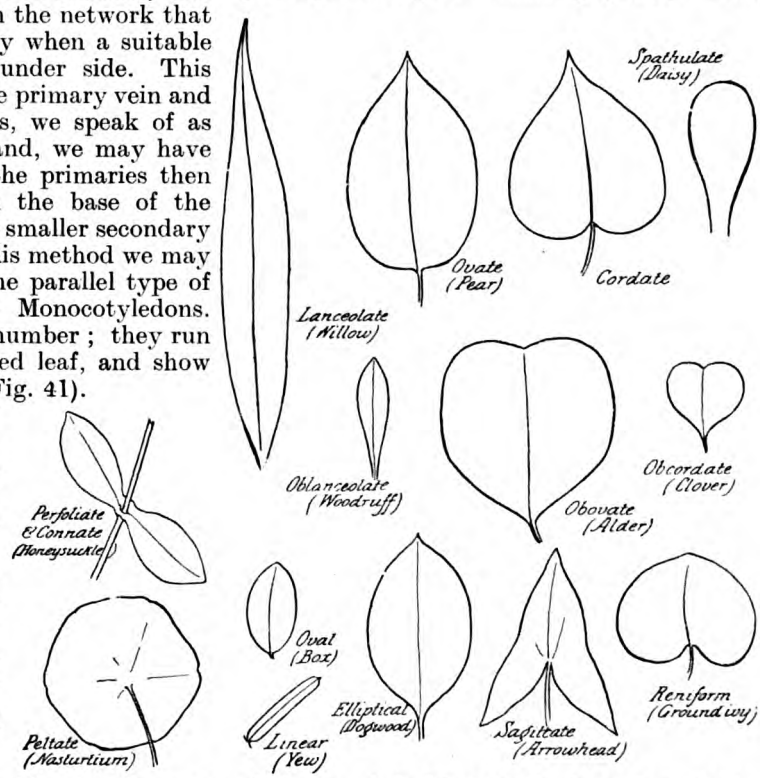


Fig. 42.—Common Leaf Shapes. A leaf is generally flat and two-sided, the under side being distinguishable by its lighter colour; though these features are liable to exceptions.

a number of leaves arise sessile at the same point they are described as *connate*.

Leaf margins may be *entire* (unbroken); *serrate* (like a saw); *bi-serrate* (like a saw with uneven teeth);

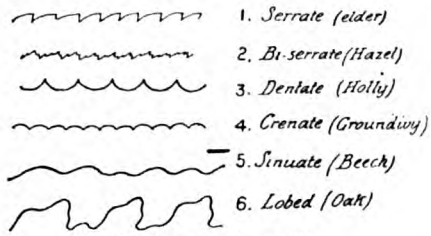


Fig. 43.—Leaf margins.

crenate (with equal semicircular lobes); *sinuate* (waved); *dentate* (sharp-toothed, as in holly). (Fig. 43).

The Leaf apex may be *acuminate; acute; mucronate; obtuse; retuse* (Fig. 44).

Sometimes the ends of the veins protrude so prominently as to make the leaf very deeply lobed.

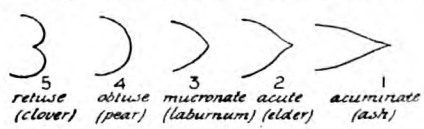


Fig. 44.—Leaf apex.

It is then described as *pinnatifid* or *palmatifid*, according to the venation.

Frequently the lobes cut down as far as the primary veins, and the leaf becomes a compound one. Common forms of compound leaf are the *pinnate; bi-pinnate* (Fig. 45); *ternate; digitate* (Fig. 46).

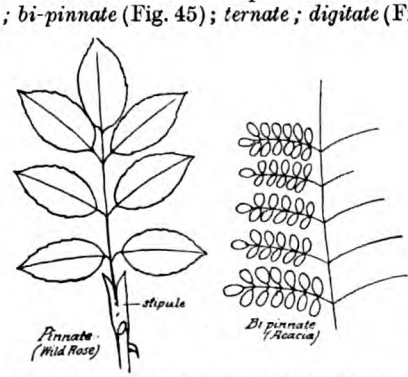


Fig. 45.—Two common forms of compound leaf (*cf.* Fig. 46).

Some leaves are dissected in an apparently complex fashion, but careful examination will show that the most difficult cases can be referred to either the pinnate or palmate type as its basis. Thus the leaf of the common buttercup (Fig. 47) is palmate, divided into three lobes, each lobe being ovate with rather deeply and unequally toothed margins.

21. Arrangement of Leaves.—The shape of a leaf is always such as to make it an efficient light-trap, conditioned by the habit of the plant, and it is very interesting to study the effect of even small points of structure in preventing the wastage of light. The ovate leaf of the elm, for example, is

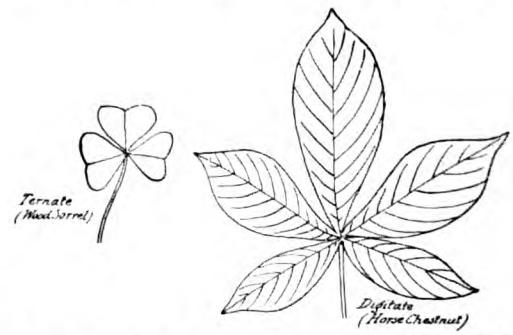


Fig. 46.—Two common forms of compound leaf (*cf.* Fig. 45).

unequally symmetrical (Fig. 50), and the object of this can easily be seen if an elm tree is observed when the sun is shining on it. The spathulate shape of the leaves of the daisy is again the result of the habit of the

Fig. 47.—Leaf of Common Buttercup.

Fig. 48.—Daisy, as seen from above.

plant. The leaves spread out in the form of a rosette which covers the ground so completely that not the smallest blade of grass will grow beneath them. Looked at from above, the rosette shows an outer circle of

Fig. 49.—Whorl of leaves (Goosegrass).

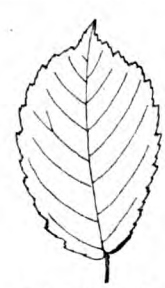


Fig. 50.—The shape of a leaf is always such as to make it an efficient light-trap: e.g. the unequally symmetrical ovate leaf of the Elm.

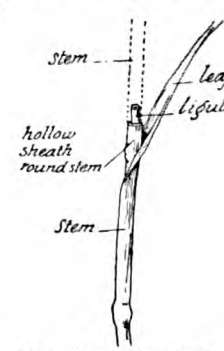


Fig. 51.—The leaf of a grass has an appendage called a ligule. The leaf is linear, and its lower part forms a sheath round the stem.

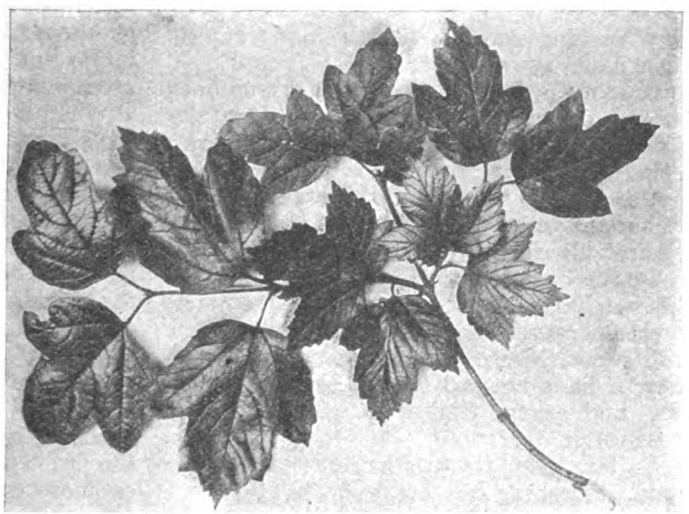
older and larger leaves, while the smaller, newer leaves cover the spaces between the stalks of the outer ones (Fig. 48). The effect of the shape is increased by the arrangement of the leaves. How effective this is may be well observed by studying the *leaf-mosaic* of such a plant as the ivy and of many others.

Think of the perfect shelter afforded by such trees as the beech. Moreover, even in the case of a tree so thickly leaved as the beech, none of the leaves is wasted or fails to catch some of the light at some time of the day. The prevailing green of an English meadow or woodland reminds us still further how completely the earth is concealed by its leafy covering.

The various types of *phyllotaxis* or leaf-arrangement have been indicated informally in Vol. III., p. 153. We summarise them again here for more convenient reference.

The points on the stem from which leaves arise are called *nodes*, the spaces between them being called *internodes*.

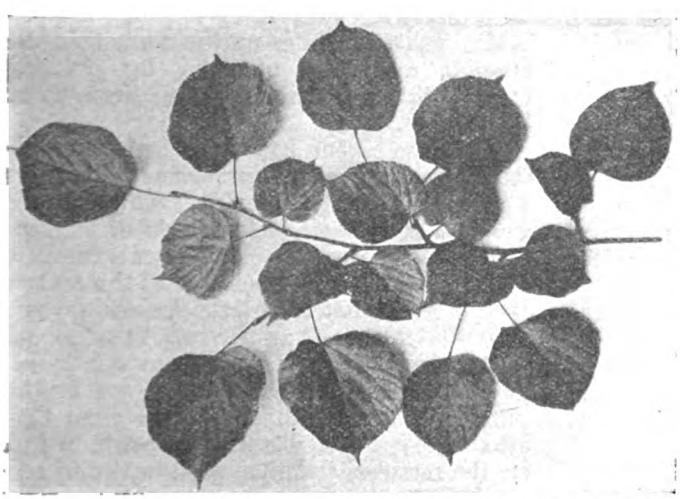
When one leaf arises at each node, the phyllotaxis is *alternate*. This arrangement is usually regular, though the rule is not always easy to follow out. It is represented by a fraction, say $\frac{2}{5}$, which represents the fact that the arrangement repeats itself in groups of five which occupy two turns of the stem.



Leaf-mosaic on a horizontal branch of the cultivated Guelder Rose.

When two leaves arise at each node the phyllotaxis is *opposite*. A very common special case of this is the decussate arrangement seen in dead-nettle, speedwell, etc. (Vol. III., p. 155, Fig. 4).

If several leaves arise at each node they form a *whorl* (Fig. 49). The whorled appearance, in the case of radical leaves, is generally due to the suppression or excessive shortening of the internodes.



Looking down on leaf-mosaic of a horizontal branch of Lime.

Starting at No. 1, we proceed spirally round the stem twice, and pass four more leaves before we arrive at No. 6, which is exactly above No. 1, and occupies a corresponding position on the stem: $\frac{2}{5}$ is a not uncommon phyllotaxis; $\frac{1}{3}$ and $\frac{3}{8}$ are also met with.

22. Modified Leaves.—Leaves sometimes have subsidiary functions to carry out, and for this purpose modifications of structure more or less complete have evolved. A simple problem, for example, is the disposal of the water that falls on them during rain. Now if the leaf of a lettuce be compared with that of a garden nasturtium, it will be observed that the lettuce leaf tends to fold inwards, so that the water that collects on it also flows inwards as down a gully. This is clearly beneficial to the plant, because it has a tap-root which does not spread outwards. The nasturtium, on the other hand, has spreading roots, and it is of advantage to it to have the water directed away from the centre, which the arrangement of the leaves quite effectively brings about. Again, the leaf of a grass is peculiar in the possession of a little appendage, called a *ligule* (Fig. 51); its function is probably to prevent water from running into the space between the sheath and the stem. E. W. E.

ANATOMY AND PHYSIOLOGY.—III

SCIENCE largely consists in close examination of facts which are known in a general way to everyone.

Let us now think of a day in the life of any working person, and consider what he does in the course of it.

One of the first things such a person does in the day is to have breakfast, to take food and drink. After this he goes to work; he may be late and have to run, if so, he will notice that he gets short of breath, and has to breathe heavily, and that his heart thumps against his ribs.

In the course of the day he will have to lift weights, or use tools, and will do so much muscular work, and if this is heavy his skin will sweat. Some time in the course of the day, if he is in good health, his bowels will act, and several times he will require to pass water.

So far, then, we see that our man takes food, breathes, his heart beats, he does muscular work, he sweats, and he gets rid of waste stuff.

In physiology we think of a man's body as a machine, and we are trying to find out how the machine works, what the body has to do in order to keep alive.

Energy and its Source

It will help us to understand the body if we consider how a steam-engine works. Sometimes a man's body is said to be like a steam-engine, but it is much more true to say that a steam-engine, which is a machine made by man, is, in some things, like the much more complicated machine, a man's body.

A steam-engine requires, first of all, coal and water. The coal has to be burnt to produce heat, which boils the water and turns it into steam. The steam is forced into a cylinder, and since steam takes up more room than water, it forces the piston out of the cylinder and so does work. By an ingenious arrangement the piston is made to turn a wheel, and so gives circular motion which can be adapted for the driving of all kinds of machinery.

The point we have to notice in this is that it is the burning of the coal which really does the work. In like manner, when a man does work with his arms and body, it is due to the burning up of fuel.

What has to be done to keep a fire burning in a furnace? First of all, it must have air; a fire will not burn at the bottom of a deep hole. Secondly, the air which has passed through the fire must escape; a furnace will not burn if the chimney is stopped up. Thirdly, coal will not burn away altogether, parts of it form ashes, and these must be cleared away. Now, coal contains an element called carbon, and when it burns the carbon combines with a gas in the air called oxygen, and this combination produces the heat which boils the water.

When a man's muscles work they act in the same way. The muscles contain carbon, and when they work the carbon combines with oxygen, and heat and work are produced. When work is done by muscles, so much carbon is used up, and food has to be taken to make up the loss. This corresponds to the stoking of the furnace.

Respiration

Here we must point out a difference between the steam-engine and the muscle. When a steam-engine is getting feeble because the fire is going out, you have only to throw on more coal, and you will get more work done. But if you have been working hard with your muscles and are exhausted, you cannot go on doing more work at once just by eating food, you must rest as well. The reason for this is that the muscle uses up part of itself when it works, and has to be renewed by food before more work can be done, and this takes time, so that rest is required.

We have seen that the oxygen of the air is necessary for the burning of coal; oxygen is also wanted to burn up the carbon in the muscles, and it is obtained by drawing breath: this corresponds to the draught of the furnace.

When the carbon has once combined with the oxygen, it is of no further use. It forms a gas called "carbon dioxide," which means one part of carbon and two parts of oxygen. This gas escapes up the chimney of a furnace, and if the chimney is blocked, and the carbon dioxide gas cannot escape, the fire will go out.

In the same way, when we breathe *out* we blow out carbon dioxide from our lungs. This corresponds to the escape of gas up the chimney of a furnace. We have seen that food is taken and digested to provide fuel for the muscles, and that we breathe in and out in order to give oxygen to the muscles, and rid them of carbonic acid. But so far there has been nothing to show how the food taken into the mouth and the air breathed in through the nose gets to the muscles of the arms and legs.

When a man runs or works hard, as we

noticed above, he feels his heart thumping against his ribs. The heart is a pump, connected with a system of tubes, the blood vessels, which are distributed all over the body, and it is by means of these that the digested food and the oxygen are collected and carried to the muscles which require them. The harder a man works the more oxygen he requires, and so the harder his heart beats.

In a steam-engine the coal is burnt to produce heat, and this heat is used to boil water to get steam, and this steam is made to turn machinery. In a man's body no water is boiled, the muscles do their work directly. When a muscle works it "contracts," gets shorter and thicker, and in contracting it combines some of its carbon with oxygen. At the same time it produces some heat, but not nearly as much as a steam-engine; still, the harder a man works the more heat his muscles produce, and the hotter he feels. A man's body, however, when in health, always keeps at about the same heat or temperature; there must, therefore, be some means of cooling him down.

This is done by sweating. The harder our man works the more he sweats, and so his temperature keeps the same.

Some of the water which is drunk during the day is got rid of by sweating, but not nearly all. Some of it is lost by "passing water," as is done several times a day. In cold weather, when people do not sweat much, they pass more water, and in hot weather, when they sweat more, they pass less.

Structure of the Body

Carbon dioxide is not the only waste substance produced in the body; there are others, particularly some which contain the element nitrogen, which are got rid of in the "water," or urine, of which we speak.

A man's body is, therefore, a machine for doing certain kinds of work. For this he requires food which is used for fuel, air for burning the fuel, and means of getting rid of the waste.

The framework of the body is as follows: There is the backbone, with the skull at the top of it. There are the ribs enclosing the chest; and the two "girdles," the upper one supporting the arms and the lower one supporting the legs.

There are thus a large number of separate bones in the body, and these are all connected with their neighbours by joints.

A joint is an arrangement by which two bones are fastened together in such a way as to allow some movements to be made and no others.

All movements of joints are made by muscles. This can be understood by a simple experiment.

Take off your coat and straighten your arm. Now bend your elbow till your hand touches your shoulder, "put your muscle up," as boys often do. Your muscle swells up into a hard lump, the bigger and harder it is the prouder boys are of it. Now straighten your arm again, and thrust it out firmly, you will find that the muscle on the back of your arm gets stiff and hard in the same way.

Muscular Movement

The elbow is a hinge joint and has a muscle on the front of it, and another on the back of it. When you bend your arm you use the muscle on the front, which "contracts," that is, gets shorter and thicker, and pulls your forearm up towards your shoulder. When you straighten your arm, the muscle on the back of the elbow contracts, and pulls your arm straight again.

All movements of the body and limbs are made in this way, all the joints have muscles on each side of them which produce the necessary movements.

Muscles do not move of themselves. When you are learning to do anything new, such as playing the piano, or knitting, or using any tools, you have to be very careful to make the right movements with your hands. You control your limbs, and make them move as you want them to go.

You do this by means of your brain, which is inside your skull, and which is connected with all your muscles by means of nerves. Nerves pass from your brain all over your body to all your muscles, and when you wish in your brain to make any movement, to strike the chord of C major on the piano, or to chisel a corner off a piece of wood, your brain sends down messages to the muscles which move your arms and fingers and they make the right movement.

At the same time there are other nerves which pass from the skin to the brain, and these are the nerves by which you feel. When you put your hand near the fire, it feels hot, when you cut it you feel pain, when you handle a billiard ball it feels smooth, when you touch a knife-blade it feels sharp. All these different sensations pass by nerves to your brain, and it is your brain that understands them. If the nerves going from your hand to your brain were cut, as sometimes happens accidentally, you

could not feel heat, or pain, or smoothness or sharpness with that hand.

Movements, then, are made by muscles contracting and moving bones and joints. And muscles are made to move by nerves which carry messages, or "impulses" from the brain. The brain also receives messages from the skin.

The muscles which contract in this way and do work require a constant supply of food to act as fuel. For this purpose food is eaten. Food consists of such things as bread and meat and fat, and only some parts of the food can be used as fuel by the muscles. There is therefore an arrangement for getting the nutritious parts out of the food, and this is called *digestion.*

The Circulatory System

The food, after being taken into the mouth and chewed up and swallowed, passes into a tube, made up of the stomach and intestines, which runs from one end of the body to the other and ends at the bottom of the trunk. It is a long tube, about six times as long as the trunk, and so has to be much coiled.

The food passes along this tube, and while there "the gastric juice" and other liquids act upon it, and these liquids dissolve out the useful parts from the food, and the rest of it is rejected at intervals.

The digested food is now in the intestines, how does it get to the muscles?

We have spoken of the heart as a pump from which blood vessels pass all over the body. The heart and blood vessels make up the *circulatory system.* The heart pumps blood into a stout vessel called the aorta, from this tube branches called arteries are given off, which go towards the head, arms, legs, and all over the body. These tubes get smaller and smaller and thinner and thinner, and when at their thinnest they are called capillaries. After a while the vessels begin to join together again and form veins. They grow thicker, and fewer, and lead back to the heart in two large trunks.

The course of the blood in these vessels can be shown by another simple experiment with one's arm. Ask someone to bare his arm to the shoulder. Now feel his pulse by putting your fingers on the front of his wrist a little way above the thumb. What you feel is an artery.

Now put your fingers on the inner part of his upper arm just above the elbow, and slightly in front. You will feel a pulse here again. Now press firmly on this with one hand and feel the pulse at the wrist with your other hand. You will find the pulse at the wrist is stopped. This shows that blood is being pumped down the arm.

Now let him swing his arm round and round a few times. The veins will stand out prominently. Grasp his arm with your hand, and the veins below the place you grasp will swell out still bigger. Let go, and stroke his arm from hand to shoulder, and the veins will grow small again. This shows that the blood is passing in the veins from hand to shoulder.

The junction between arteries and veins is made by the capillaries.

The capillaries are spread out all round the intestines, all through the muscles, and all over the body. The digested food in the intestines passes through the capillaries, and so into the blood vessels, and is carried to the muscles, where it passes out again and is used up as fuel. Thus the muscles are supplied with food.

The food cannot be used as fuel without oxygen, the gas present in the air. This also is carried in the blood vessels.

Waste Products

Everyone knows that blood is red. The colour is due to a red colouring matter, or "pigment," which has the power of absorbing oxygen, when exposed to the air, and giving it up in the muscles when they are at work.

There is an arrangement by which the blood is exposed to the air and gets fresh oxygen, this is done by breathing, and the arrangement is called the *respiratory system.*

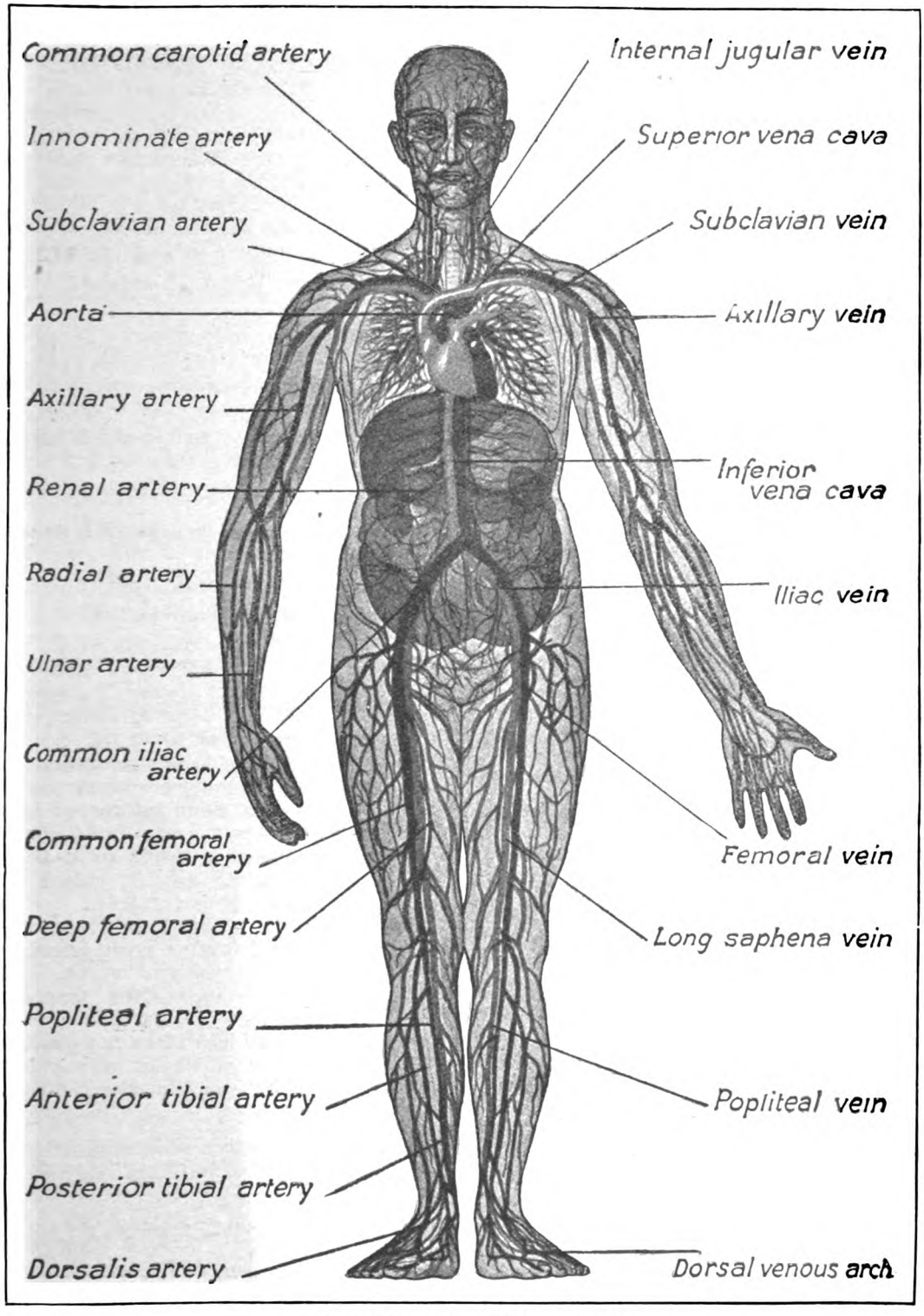
When we take a deep breath we draw air into our lungs, and the blood in the capillaries of the lungs takes up oxygen from this air. The blood is thus charged with oxygen.

When carbon is burnt up by the muscles, the gas carbon dioxide is produced, and must be got rid of. It passes into the blood just as the oxygen passes out of it, and when it reaches the lungs it is given up to the air in them, so that when we breathe *out* we blow out carbon dioxide, a waste product.

This getting rid of waste substances is called in physiology *excretion.*

There are, as we said above, other things to be got rid of besides carbon dioxide, especially those containing nitrogen. They are excreted in the water or urine.

Urine comes from the kidneys. There are two organs inside the belly, from each of which a tube passes, which leads at last outside the body. When blood flows through the capillaries of the kidney water passes out of them into the tubes of the kidney, and in this water are dissolved the substances which make up urine. D. W. C.-J.



THE CIRCULATORY SYSTEM.

The heart pumps blood into a stout vessel called the *aorta*. This tube branches into arteries (shown black) which carry blood all over the body, the blood returning to the heart by means of the veins (shown grey) which are connected with the arteries by capillaries.

Continued from Vol. III., p. 485.

LANGUAGES:

Contributors:—LATIN, GREEK and FRENCH (E. A. Baker, M.A., D.Lit.). GERMAN (M. A. Lewenz, M.A.[Lond.]). SPANISH, RUSSIAN and ITALIAN (Alfred Calvert, First Prizeman in Modern Languages, R.S.A., London).

LATIN.—XXV

The Accusative Case (*Continued*)

(*c*) NAMES of objects towards which motion is expressed are put in the accusative, either with or without a preposition.

(1) With the name of a town or small island the accusative is used without a preposition, thus :—

Sexto die **Delum** venimus.
On the sixth day we came to Delos.
Legati **Athenas** missi sunt.
The ambassadors were sent to Athens.

The words **dŏmŭs**, *home*, and **rūs**, *country*, are similarly used in the accusative without prepositions, thus :—

Ducite ab urbe **domum**, mea carmina, ducite Daphnim.
Bring Daphnis home, bring him from the town, my songs.
Meam **domum** rediit.
He returned to my house.
Ego **rus** ibo.
I will go into the country.

It is worth noting that our idiom is on all fours ; thus we say " I went to France," but " they came home early."

(2) With words other than the names of towns or small islands the accusative is preceded by a preposition, thus :—

Ego ire **in Piraeum** volo.
I wish to go to the Piraeus.
Ad urbem hostes venerunt.
The enemy came to (i.e. *near to*) *the town.*
I **in crucem.**
Go and be hanged (literally, *go to the cross*).

With the poets, however, words other than the names of towns or small islands are sometimes used in the accusative without a preposition after verbs of motion, as in :—

Troiae primus ab oris **Italiam** venit.
He was the first who came to Italy from the shores of Troy.
Hinc ibimus **Afros.**
We will go hence to Africa (literally, *the Afri*).

The accusative supine denotes the object towards which motion is expressed, as in :—

Lusum it Maecenas ; **dormitum** ego Vergiliusque
Maecenas goes to play, I and Virgil to sleep.

(*d*) The subject of a verb in the infinitive is put in the accusative, thus :—

Quum inter augures constet **imparem numerum** debere esse.
When it was known among the augurs that the number ought to be uneven.

This usage probably arose from the use of the accusative as the object of a finite verb, as in the sentence :—

Cognoverunt augures **imparem numerum** debere esse.
The augurs know that the number ought to be uneven.

The Dative Case

The chief uses of the dative are to denote :

(*a*) The indirect object, that is the person or thing interested in or affected by the action of the verb.

(*b*) The purpose or result of a thing. This latter use is called the predicative dative.

(*a*) The indirect object is denoted by the dative after both transitive and intransitive verbs. The dative is used after transitive verbs that express *giving, promising, telling, showing*, etc., the meaning of which is not complete with only a direct object.

Examples :—

Lycurgus agros locupletium **plebi** dedit.
Lycurgus gave the fields of the rich to the people.
Aulus Postumius aedem **Castori** ac **Polluci** in foro dedicavit.
Aulus Postumius dedicated a temple in the forum to Castor and Pollux.
Erranti comiter monstrant viam.
They kindly show the way to the wanderer.
Polliceor hoc **vobis**, Quirites.
I promise you this, Quirites.

Intransitive verbs that take a dative of the indirect object comprise those which

express *helping, favouring, pleasing, injuring, sparing, obeying, commanding, seeming*, etc.

Examples :—

Nobis amici auxiliantur.
Our friends help us.
Nihil **hostibus** nocebant Romani.
The Romans did no injury to their enemies.
Iamque ibat **dicto** parens.
And now he went, obeying what was said.
Imperare **sibi**, maximum imperium est.
The greatest mastery is to master oneself.

Note that some verbs with these meanings do not take the dative; thus **iŭvō**, *help*, **dēlectō**, *delight*, **iŭbĕō**, *command*, and **laedō**, *hurt*, are transitive verbs taking the accusative.

With the verbs taking the dative must be grouped **nūbō**, *marry* (used of the woman), as in :—

Venus nupsit Vulcano, *Venus was married to Vulcan.*

Verbs, both transitive and intransitive, compounded with certain prepositions or particles take the dative of the indirect object. The following rhyme will serve to keep these particles in mind :—

In	**ăd**	**antĕ**	**sătĭs**	**dē**
cum	**ŏb**	**bĕnĕ**	**mălĕ**	**prae**
sŭb	**post**	**sŭpĕr**	**intĕr**	**rĕ**

Examples :—

Leges omnium salutem singulorum **saluti** anteponunt.
The laws place the safety of all before the safety of individuals.
Certis rebus certa signa praecurrunt.
Certain signs precede certain things.
Aetas **aetati** succedit.
Age succeeds age.

Many impersonal verbs, such as **accĭdĭt**, **lĭcĕt**, **plăcĕt**, **praestăt**, etc., take the dative of the indirect object, thus :—

Zenoni placuit, bonum esse solum, quod honestum esset.
Zeno held (literally, *it pleased Zeno*) *that that alone was good which was honourable.*
Si quid **mihi** humanitus accidisset.
If anything human should have happened to me.

The dative is used with adjectives and adverbs denoting likeness, friendliness, service, etc., or the opposite, such, in short, as are allied in meaning if not in derivation to the verbs mentioned above as taking a dative of the indirect object.

Examples :—

Bruto amicissimus erat.
He was most friendly to Brutus.
Romulus **multitudini** gratior fuit quam **Patribus**
Romulus was more popular with the mob than with the Fathers.

The dative of advantage (**dătīvŭs commŏdī**) and of disadvantage (**dătīvŭs incommŏdī**) is an extension of this use, as in:—

Non solum nobis divites esse volumus, sed **liberis, propinquis, amicis**, maximeque **reipublicae**.
We wish to be rich not only for ourselves, but for our children, our neighbours, friends, and, above all, for the state.

Sometimes this dative implies not so much interest as point of view, as in :—

Sapientibus omnibus stultus erat.
He was a fool in the eyes of all wise men.

The so-called ethic dative may be regarded as a variety of the dative of advantage. In this usage, by a kind of rhetorical figure, the noun or personal pronoun in the dative stands for a person concerned indirectly with the statement.

Examples :—

Quid **mihi** Celsus agit ?
What is Celsus doing, I wonder? or *What is my Celsus doing?*
Spargit **tibi** silva frondes.
The wood scatters you her leaves.

This idiom may be paralleled in English, though it is rarely found in modern writers. Thus we find in Shakespeare the following lines :—

"See how the river comes *me* cranking in."
"Give *me* your present to one Master Bassanio."

A dative, analogous to the ethic dative in signification, is found after some interjections, thus :—

Heu **misero mihi !**
Alas for wretched me!
Ecce **tibi**, mane accepi tuas litteras.
You behold this morning I received your letter.

The dative is sometimes used to denote possession, usually with parts of the verb **essĕ**, *to be*, which may often be rendered by *to have*, as in :—

Est mihi hortus.
I have a garden.
Diviti sunt multi amici.
The rich man has many friends.

The dative is used to denote the agent after gerunds, the gerundives, or verbal adjectives ending in **-bĭlĭs**, and sometimes after the perfect participle.

Examples :—

Legendi sunt **tibi** multi libri.
Many books must be read by you.
Multis ille **bonis** flebilis occidit.
He died worthy to be lamented by many good men.

In a few passages in the poets this dative of the agent is found after other tenses of the passive where ordinarily **ăb** would be used with the ablative, as in Horace's—

Carmina quae scribuntur aquae **potoribus.**
Songs that are composed by drinkers of water.

After verbs of motion the dative is sometimes used in poetry to denote the place towards which the motion is directed.

It clamor **caelo**.
The shout goes up to the sky.

(*b*) The predicative dative is a dative of purpose or result. It is used with certain abstract substantives in the singular number, usually with the verb **essĕ**, *to be*, forming a secondary predicate of the subject, or a primary predicate of the direct object of the sentence. It might seem, indeed, that the nominative would be more naturally used in such a construction. The following are examples :—

Exemplo est magni formica laboris.
The ant is an example of great industry.
Cui **bono** fuit ?
To whose advantage was it ? (literally, *to whom was it for an advantage ?*)

In the last two examples observe that there is a double dative, that of the indirect object as well as the predicative dative, as in :—

Magno esse **Germanis dolori** Ariovisti mortem.
(*That*) *the death of Ariovistus is a great trouble to the Germani.*

Exercise 24

Translate into English :—

1. Idonea mihi Laelii persona visa est quae de amicitia dissereret. 2. Filium suum foras ad propinquum suum quendam misit. 3. Italiam fato profugus Laviniaque venit littora. 4. Exercitum fundit fugatque, fusum persequitur. 5. Fuisse credo tum quoque aliquos qui discerptum regem patrum membris tacite arguerent. 6. I domum.

Translate into Latin :—

1. He selected a spot suitable for a camp. 2. When the day arrived which he had decided upon with the ambassadors. 3. From this battle about a hundred and thirty thousand men survived. 4. Jugartha prepares to govern the whole of Numidia. 5. The virgin marries him whom Caecilia had married. 6. He intersperses among the cavalry auxiliaries of light-armed troops.

E. A. B.

FRENCH.—XXV

The Irregular Verbs of the Fourth Conjugation are continued in the following list:

Class II

ABSOUDRE, *to absolve*

Absoudre, absolvant, absous, absoute, j'absous.

Ind. pres. : j'absous, il absout, nous absolvons, etc.
Imperf. : j'absolvais, nous absolvions, etc.
Past def. : wanting
Fut. : j'absoudrai, nous absoudrons, etc.
Cond. pres. : j'absoudrais, nous absoudrions, etc.
Imper. : absous, absolvons, absolvez
Subj. pres. : que j'absolve, que nous absolvions, etc.
Imperf. : wanting

BOIRE, *to drink*

Boire, buvant, bu, je bois, je bus.

Ind. pres. : je bois, nous buvons, etc.
Imperf. : je buvais, nous buvions, etc.
Past def. : je bus, nous bûmes, etc.
Fut. : je boirai, nous boirons, etc.
Cond. pres. : je boirais, nous boirions, etc.
Imper. : bois, buvons, buvez
Subj. pres. : que je boive, que nous buvions, qu'ils boivent, etc.
Imperf. : que je busse, que nous bussions, etc.

CONCLURE, *to conclude*

Conclure, concluant, conclu, je conclus, je conclus.

Ind. pres. : je conclus, nous concluons, etc.
Imperf. : je concluais, nous concluions, etc.
Past def. : je conclus, nous conclûmes, etc.
Fut. : je conclurai, nous conclurons, etc.
Cond. pres. : je conclurais, nous conclurions, etc.
Imper. : conclus, concluons, concluez
Subj. pres. : que je conclue, que nous concluions, qu'ils concluent, etc.
Imperf. : que je conclusse, que nous conclussions, etc.

CONNAÎTRE, *to know*

Connaître, connaissant, connu, je connais, je connus.

Ind. pres. : je connais, il connaît, nous connaissons, ils connaissent, etc.
Imperf. : je connaissais, nous connaissions, etc.
Past def. : je connus, nous connûmes, etc.
Fut. : je connaîtrai, nous connaîtrons, etc.
Cond. pres. : je connaîtrais, nous connaîtrions, etc.
Imper. : connais, connaissons, connaissez
Subj. pres. : que je connaisse, que nous connaissions, etc.
Imperf. : que je connusse, que nous connussions, etc.

CROIRE, *to believe*

Croire, croyant, cru, je crois, je crus.

Ind. pres. : je crois, il croit, nous croyons, ils croient, etc.
Imperf. : je croyais, nous croyions, etc.
Past def. : je crus, nous crûmes, etc.
Fut. : je croirai, nous croirons, etc.
Cond. pres. : je croirais, nous croirions, etc.
Imper. : crois, croyons, croyez
Subj. pres. : que je croie, que nous croyions, qu'ils croient, etc.
Imperf. : que je crusse, que nous crussions, etc.

CROÎTRE, *to grow*

Croître, croissant, crû, je crois, je crûs.

Ind. pres. : je crois, il croît, nous croissons, etc.
Imperf. : je croissais, nous croissions, etc.
Past. def. : je crûs, nous crûmes, etc.
Fut. : je croîtrai, nous croîtrons, etc.
Cond. pres. : je croîtrais, nous croîtrions, etc.
Imper. : crois, croissons, croissez
Subj. pres. : que je croisse, que nous croissions, etc.
Imperf. : que je crûsse, que nous crûssions, etc.

LIRE, *to read*

Lire, lisant, lu, je lis, je lus.

Ind. pres. : je lis, nous lisons, etc.
Imperf. : je lisais, nous lisions, etc.
Past def. : je lus, nous lûmes, etc.
Fut. : je lirai, nous lirons, etc.
Cond. pres. : je lirais, nous lirions, etc.
Imper. : lis, lisons, lisez
Subj. pres. : que je lise, que nous lisions, qu'ils lisent, etc.
Imperf. : que je lusse, que nous lussions, etc.

MOUDRE, *to grind*

Moudre, moulant, moulu, je mouds, je moulus.

Ind. pres. : je mouds, tu mouds, il moud, nous moulons, vous moulez, ils moulent.
Imperf. : je moulais, nous moulions, etc.
Past def. : je moulus, nous moulûmes, etc.
Fut. : je moudrai, nous moudrons, etc.
Cond. pres. : je moudrais, nous moudrions, etc.
Imper. : mouds, moulons, moulez
Subj. pres. : que je moule, que nous moulions, etc.
Imperf. : que je moulusse, que nous moulussions, etc.

PARAÎTRE, *to appear*

Paraître, paraissant, paru, je parais, je parus.

Conjugated like **connaître.**

PLAIRE, *to please*

Plaire, plaisant, plu, je plais, je plus.

Ind. pres. : je plais, tu plais, il plaît, nous plaisons, vous plaisez, ils plaisent.
Imperf. : je plaisais, nous plaisions, etc.
Past def. : je plus, nous plûmes, etc.
Fut. : je plairai, nous plairons, etc.
Cond. pres. : je plairais, nous plairions, etc.
Imper. : plais, plaisons, plaisez
Subj. pres. : que je plaise, que nous plaisions, etc.
Imperf. : que je plusse, que nous plussions, etc.

RÉSOUDRE, *to resolve*

Résoudre, résolvant, résolu, je résous, je résolus.

Conjugated like **absoudre**, but has past definite **je résolus**, etc., and imperf. subj. **je résolusse**, etc.

TAIRE, *to keep silent*

Taire, taisant, tu, je tais, je tus.

Conjugated like **plaire.**

TRAIRE, *to milk*

Traire, trayant, trait, je trais.

Ind. pres. : je trais, tu trais, il trait, nous trayons, vous trayez, ils traient.
Imperf. : je trayais, nous trayions, etc.
Past def. : wanting
Fut. : je trairai, nous trairons, etc.
Cond. pres. : je trairais, nous trairions, etc.
Imper. : trais, trayons, trayez
Subj. pres. : que je traie, que nous trayions, qu'ils traient, etc.
Imperf. : wanting

VIVRE, *to live*

Vivre, vivant, vécu, je vis, je vécus.

Ind. pres. : je vis, il vit, nous vivons, ils vivent, etc.
Imperf. : je vivais, nous vivions, etc.
Past def. : je vécus, nous vécûmes, etc.
Fut. : je vivrai, nous vivrons, etc.
Cond. pres. : je vivrais, nous vivrions, etc.
Imper. : vis, vivons, vivez
Subj. pres. : que je vive, que nous vivions, etc.
Imperf. : que je vécusse, que vécussions, etc.

VOCABULARY

bâtir, *to build.*
changer, *to change.*
changer d'air, *to take a change of air.*
certes, *certainly.*
la chandelle, *the candle.*
un contemporain, *a contemporary.*
le débat, *the discussion.*
déplaire, *to displease.*
le devoir, *duty.*
le geste, *the gesture.*
le gigot, *the leg* (of mutton).
une historiette, *a little story.*
imaginer, *to imagine.*
juger, *to judge.*
le mouton, *mutton, the sheep.*
le nez, *the nose.*
obéir (à), *to obey.*
le précepteur, *the teacher, tutor.*
prier, *to pray.*
ressentir, *to feel, to experience.*
le secours, *aid, help.*
la société, *the company.*
tard, *late.*
le visage, *the face.*

Exercise 47

1. Ne courûtes-vous pas au secours de votre frère aussitôt que vous le vîtes en danger? 2. Lûtes-vous hier le livre que je vous ai prêté? 3. Je buvais un verre de vin. 4. Croyez-vous qu'il viendra? 5. Ils se plurent beaucoup dans votre société. 6. Vous devez étudier beaucoup pour être si fatigué. 7. Cela vous rendra malade. 8. Cela paraît comme le nez au milieu du visage. 9. Faites votre devoir. 10. Ils disparurent tout de suite. 11. Ne va pas t'imaginer qu'elle me déplaise en quelque chose. 12. D'où cela peut-il venir? 13. C'est où vous voyez mal. 14. Il apparaissait à nu dans le débat de ce jour. 15. Vous croyez voir les gestes de cinq cents contemporains. 16. Je croyais que c'était vous qui deviez me dire quelque chose. Je n'en crois rien. 17. Je l'ai ressenti, l'hiver dernier, par une nuit de décembre. 18. Ce jour-là, je compris ce que c'était d'avoir peur. 19. Je l'ai su mieux encore une autre fois. 20. Je n'appris tout cela que plus tard.

Exercise 48

1. I read it the day before yesterday. 2. At what time did the merchant come this morning? 3. Have you been learning German more than a year? 4. I have been learning it more than four years. 5. The doctor advises him to take a change of air. 6. I shall have a house built next year. 7. Have you had that leg of mutton boiled? 8. Will you pay attention to your work? 9. I should like the king to judge by this how far he is from knowing the truth. 10. The king began to laugh. 11. I have read that little book. 12. I must tell you a little story. 13. Sir, I pray you, read this little book. 14. Obey your teacher. 15. I always obey him. 16. Nevertheless, she was greatly bored. 17. She was pleased most of all at being thought incomparable. 18. She was certainly surprised when she read (it). 19. At present no one knew him any more. 20. He put out the candles.

E. A. B.

GERMAN.—XXII

THE following list gives illustrations of the different meanings of Prefixes when compounded separably and inseparably:

Separable.	Inseparable.
Durch	
durch'beten, to go through (one's prayers).	durchbe'ten, to spend (the night) in prayer.
durch'blättern, to turn over the leaves (of a book) to the end.	durchblät'tern, to skim (a book).
durch'brechen, to break or burst through.	durchbre'chen, to perforate.
durch'bringen, to carry through, squander.	durchbrin'gen, to spend, pass (time).
durch'dringen, to get through.	durchdrin'gen, to penetrate, permeate.
durch'fegen, to sweep thoroughly.	durchfe'gen, to sweep through rapidly (of motion).
durch'gehen, to get through, to run away, to pass (of a law), to peruse.	durchge'hen, to walk through, to peruse.
durch'ſchauen, to peep through.	durchſchau'en, to examine, to fathom.
durch'ſetzen, to burst through, to accomplish, to enforce.	durchſe'tzen, to mix with, to intersperse.
Über	
ü'berbeugen, to bend over.	überbeu'gen, to bend too much.
ü'berbringen, to get or bring over.	überbrin'gen, to transmit, deliver.
ü'berdecken, to spread over.	überde'cken, to cover, to make a ceiling or roof over.
ü'berfahren, to cross or put across by a ferry.	überfah'ren, to cross, to drive or run over.
ü'bergehen, to pass along over, to overflow, to be transferred.	überge'hen, to pass over, to peruse, to overlook.
ü'bergießen, to pour over, spill.	übergie'ßen, to pour on to.
ü'berlegen, to lay upon, to shift (the helm).	überle'gen, to overburden, to think over, ponder.
ü'berſchlagen, to tumble, overlap, to turn over, to apply.	überſchla'gen, to cover completely (with something), to incase, to miss, to skip, to make a rough estimate.
ü'berſetzen, to put over, transport, to jump over, to cross.	überſe'tzen, to cover all over, to overstock, to overrate, to translate.
ü'bertreiben, to drive across.	übertrei'ben, to overdrive, to exaggerate.
Um	
um'bauen, to alter a building, to rebuild.	umbau'en, to surround with buildings.
um'blaſen, to blow down or over.	umbla'ſen, to blow round from all sides.
um'dichten, to alter a poem, to re-write a poem or story.	umdich'ten, to invest with poetry.
um'fahren, to drive a roundabout way.	umfah'ren, to drive round (a thing).
um'faſſen, to set (jewels) anew.	umfaſ'ſen, to embrace, comprise.
um'gehen, to go about, to revolve, to go a roundabout way, to manage, to entertain (an idea), to have intercourse.	umgeh'en, to perambulate, to evade.
um'pflanzen, to transplant.	umpflan'zen, to surround with plants.
um'reiten, to ride down (a person).	umrei'ten, to ride round.
um'ſchreiben, to rewrite.	umſchrei'ben, to write all round, to paraphrase, to circumscribe.
Unter	
un'terhalten, to keep or hold under.	unterhal'ten, to converse, to maintain, to entertain.
un'terlegen, to lay or put under.	unterle'gen, to underlay.
un'tergehen, to go down, to perish.	unterblei'ben, to remain undone.
	unterbre'chen, to interrupt.
	unterlie'gen, to succumb.
un'terſchreiben, to write underneath.	unterſchrei'ben, to affix one's signature.
Hinter	
hin'tergehen, to go last.	hinterge'hen, to deceive.
Wider	
wi'derlegen, to lay against.	widerle'gen, to refute.
Wieder	
wie'derſprechen, to speak again.	wiederſpre'chen, to contradict.

Otherwise wider is mostly inseparable, and wieder with the one exception given above, is separable.

Separable prefixes are used in conjunction with verbs compounded with inseparable prefixes. Thus: heraufbeſchwören, *to conjure up;* vor'enthalten, *to withhold.*

There are two classes of verbs compounded with other adverbs, nouns, and adjectives:

i. Those that are inseparably compounded and are treated exactly as if they formed one verb. Thus: handhaben, *to handle*, liebkoſen, *to caress*. These are treated like any ordinary verb (not like the verbs compounded with inseparable prefixes), and the ge of the past participle is prefixed in the usual way.

ii. Those that are separably compounded with adverbs, adjectives, and nouns, and which really consist of two separate words but are written in one word and conjugated exactly like ordinary separable compounds. Thus: heimleuchten, *to light on the way home;* ſtattfinden, *to take place;* fehlſchlagen, *to miscarry*.

Note that verbs of the first class, when accented on the second compound (like inseparable compounds), drop the ge of the past participle. Thus: frohlo'cken, *to exult*, past participle, frohlockt'.

The student must learn to distinguish from the above compound verbs those verbs which are formed from compound nouns. Such are: ratſchlagen, *to consult*, from Ratſchlag, *advice;* frühſtücken, *to breakfast* or *lunch*, from Frühſtück, *breakfast*.

Many such verbs are formed with inseparable prefixes. Thus: beeinfluſſen, *to influence*, from Einfluß, *influence;* beglückwünſchen, *to congratulate*, from Glückwunſch, *congratulation*.

Adjuncts of the Verb

A verb may have various adjuncts. It can have the following:

(1) A direct object: der Knabe hat einen Hund, *the boy has a dog*.

(2) An indirect object: ſie gehorcht mir, *she obeys me;* ich gedenke meines Eides, *I remember my oath*.

(3) A direct and an indirect object: er gibt ihnen das Buch, *he gives them the book*.

(4) A noun or pronoun used as a complement to the verb. Such a noun is in the nominative case, and is called a subjective complement when used to complete the sense of an intransitive verb. Thus: er iſt mein Vater, *he is my father;* dieſer junge Mann wird Soldat, *this young man is going to be a soldier*.

The commonest of these intransitive verbs of incomplete predication (verbs which require something other than an object to complete their meaning) are ſein, *to be;* werden, *to become;* bleiben, *to remain;* ſcheinen, *to seem;* dünken and däuchten (both used impersonally), *to seem*. Such a noun is in the accusative case, and is called the objective complement when it completes the meaning of a transitive verb of incomplete predication. Thus: er nannte mich einen Helden, *he called me a hero*. The commonest transitive verbs of incomplete predication are fragen, *to ask;* bitten, *to beg;* lehren, *to teach;* and nennen and heißen, *to call*.

(5) An adjective used predicatively either with verbs of complete or with verbs of incomplete predication. Thus: ſie ſaßen bleich und regungslos, *they sat pale and motionless;* er iſt krank, *he is ill;* er hält ihn warm, *he holds him warm*.

(6) An adverb of time, place, manner, etc. Thus: ich werde bald kommen, *I shall come soon;* mein Onkel iſt hier, *my uncle is here;* ſie ſingt ſchön, *she sings beautifully*.

(7) A prepositional phrase made up of a preposition and a noun or pronoun with or without adjuncts. Thus: er geht in den Garten, *he goes into the garden;* er behandelte mich mit großer Sorgfalt, *he treated me with great care*.

VOCABULARY

Heiterkeit, w.f., *joy, mirth*.
ein'nehmen, s., *to encompass*.
Frühling, s.m.2, *spring*.
genießen, s., *to enjoy*.
ſchaffen s., *to create, make*.
verſinken, s., *to immerse, sink*.
leiden, s., *to suffer*.
Strich, s.m.2, *stroke, line*.
Augenblick, s.m.2, *moment*.
dampfen, w., *to steam*
undurchdringlich, *impenetrable*.
Wald, s.m.3, *forest*.
Heiligtum, s.n.3, *shrine*.
Gras, s.n.3, *grass*.
Bach, s.m.2, *brook*.
merkwürdig, *remarkable*.
Halm, s.m.2, *blade* (of grass).
unergründlich, *unfathomable*.
Mücke, w.f., *gnat*.
allmächtig, *almighty*.
Wehen, s.n.1, *breath*.
Wonne, w.f., *bliss*.
erhalten, *to uphold, maintain*.
Geliebte, w.f., *sweetheart, love*.
ausdrücken, w., *to express*.
ein'hauchen, w., *to inspire, imbue*.
unendlich, *infinite*.
erliegen, s., *to succumb*.
Seele, w.f. *soul*.
ſüß *sweet*.
Morgen, s.m.1, *morning*.
allein, *alone*.
Daſein, s.n.1, *existence*.
Kunſt, s.f.2, *art*.
zeichnen, w., *to draw*.
Maler, s.m.1, *painter*.
Tal, s.n.3, *valley*.
Oberfläche, w.f., *surface*.
Finſterniß, w.f., *darkness*.
ruhen, w., *to rest*.
ſich ſtehlen in, *to steal into*.
fallen, s., *to fall*.
mannichfaltig, *manifold*.
Wimmeln, s.n.1, *swarm*.
unzählig, *innumerable*.
Wurm, s.m.3, *worm*.
Gegenwart, s.f., *presence*.
Bild, s.n.3, *image*.
alliebend, *all loving*.
ſchweben, w., *to soar, hover*.
dämmern, w., *to dawn*, or *to grow dusk*.
ſich ſehnen, w., *to long, yearn*.
Papier, s.n.2, *paper*.
Spiegel, s.m.1, *mirror*.
zu Grunde gehen, *to founder, perish*.
Herrlichkeit, w.f., *glory*
Erſcheinung, w.f., *appearance, phenomenon*.

Exercise 51

Eine wunderbare Heiterkeit hat meine ganze Seele eingenommen, gleich den süßen Frühlingsmorgen, die ich mit ganzem Herzen genieße. Ich bin allein, und freue[1] mich meines Lebens in dieser Gegend, die für solche Seelen geschaffen ist, wie die meine[2]. Ich bin so glücklich, mein Bester[3], so ganz in dem Gefühle von ruhigem Dasein versunken, daß meine Kunst darunter leidet. Ich könnte jetzt nicht zeichnen, nicht einen Strich, und bin[4] nie ein größerer Maler gewesen, als in diesen Augenblicken. Wenn[5] das liebe Tal um mich dampft, und die Sonne an der Oberfläche der undurchdringlichen Finsterniß meines Waldes ruht, und nur einzelne Strahlen sich in das innere Heiligtum stehlen, ich dann im hohen Grase am fallenden Bache liege, und näher an der Erde tausend mannichfaltige Gräschen mir merkwürdig werden; wenn ich das Wimmeln der kleinen Welt zwischen Halmen, die unzähligen, unergründlichen Gestalten der Würmchen, der Mückchen näher an meinem Herzen fühle, und fühle[6] die Gegenwart des Allmächtigen, der uns nach seinem Bilde schuf, das Wehen des Alliebenden, der uns in ewiger Wonne schwebend trägt und erhält — mein Freund, wenn's dann um meine Augen dämmert[7], und die Welt um mich her und der Himmel ganz in meiner Seele ruht, wie die Gestalt einer Geliebten; dann sehne ich mich oft, und denke: ach, könntest[8] du das wieder ausdrücken, könntest dem Papiere das einhauchen, was so voll, so warm in dir lebt[9], daß es würde[10] der Spiegel deiner Seele, wie[11] deine Seele ist der Spiegel des unendlichen Gottes[12]. — Mein Freund! — Aber ich gehe darüber zu Grunde, ich erliege unter der Gewalt der Herrlichkeit dieser Erscheinungen.

J. W. von Goethe.

NOTES:

(1) sich freuen either governs the genitive or is followed by the preposition über and the accusative. (2) die meine, possessive pronoun *mine*. (3) mein Bester, *my dear fellow*. (4) bin, the subject ich must be supplied from the preceding clause. (5) wenn . . . dampft; the conjunction wenn is understood before all the following clauses whose verbs are ruht, stehlen, liege, werden. (6) und fühle; this clause is really also dependent on wenn, but the construction is changed to that of a principal clause; this change is legitimate in the last of a long series of clauses and gives it greater emphasis. It should not, however, be imitated by the student, who should follow the rules closely and take no liberties. (7) um meine Augen dämmert, literally, *grows twilight around my eyes*, i.e. my eyes grow dim. (8) könntest du, conjunctive with inverted order to express a wish. (9) in dir lebt, literally *lives in thee*, i.e. in thy consciousness. (10) daß . . . Spiegel, in this dependent clause we should expect to find the verb würde at the end; the order of a principal clause, however, is used here in imitation of older or Biblical language. (11) wie . . . Spiegel, for order of words *see* (10). (12) ach . . . Gottes. Here the writer is addressing himself. In translating it will read better to use the first person.

VOCABULARY

silly, albern.
abuse, beschimpfen, w.
way, Weise, w.f.
compassion, Mitleid, s.n.
depend upon, sich verlassen(s.), auf(gov.acc.).
ignorant (uneducated), ungebildet.
mistake, irren, w.
for, vor.
consideration, Rücksicht, w.f.
suffer, leiden, s.
get over, überwinden (insep.).
to be of use, nützen (gov. dat.).
own, eigen.
vex, ärgern, w.
nerve, Nerv, w.m.
respect, Achtung, w.f.
mention, sprechen (s.) von.
at least, mindestens.
hope, hoffen, w.
live to see, erleben, w.
since, da.

Exercise 52 (*continued from* 51)

"None[1] of our daughters have much to recommend them," replied he; "they are all silly and ignorant, like other girls."

"Mr. Bennet, how can you abuse your own children in[2] such a way? You[3] take delight in vexing[4] me. You have no compassion on[5] my poor nerves."

"You mistake me,[6] my dear. I have a high[7] respect for your nerves. They are my[8] old friends. I have heard you mention them with consideration these[9] twenty years at least."

"Ah! you do not know what[10] I suffer."

"But[11] I hope you will get over it, and live[12] to see many young men of[13] four thousand a year come[14] into the neighbourhood."

"It will be of no use to us if twenty such should come, since you will not visit them."

"Depend upon it, my dear, when there are twenty[15] I will visit them all."

NOTES:

(1) None . . . daughters, say, our daughters have no special merits (besondere Vorzüge). (2) In, auf (governs acc.). (3) You take delight, say, it gives you pleasure, es macht dir Vergnügen. (4) In vexing, say, to vex. (5) On, mit. (6) Omit "me." (7) A high, say, the greatest. (8) Omit "my." (9) These twenty years at least, say, since (seit) at least twenty years you mention. (10) What, say, how. (11) Omit "but," and put doch after I hope. (12) Say, live to see it that. (13) Of, say, with an income of. (14) Come into, ziehen in (gov. acc.). (15) Say, when twenty are there.

Key to Exercise 49

On a cold October day two men drove past the gate railings of the town of Rosmin into the plain which spread before them, uniform and endless. Anton sat wrapped in his fur coat, his hat well (deep) over his forehead, beside him young Sturm in an old riding cloak, his soldier's cap perched jauntily on one ear. In front the farm servant of a citizen (who carried on agriculture) crouched on a bundle of straw, and whipped the little horses. The wind with its gigantic broom swept sand and wisps of straw over the fields of stubble. The road was a wide field-track without ditches or (and) rows of trees. The horses waded at one time through pools of water hollowed out by much driving, at another through deep sand. Yellow sand gleamed everywhere from among (between) the scanty green of the fields where a field-mouse had placed the entrance to its hole, or where the busy mole had worked to the best of its ability to diversify (interrupt) the plain with little chains of hills. In the hollows of the ground stood slimy water; at such places the hollow trunks of old willows stretched their crippled arms into the air, their twigs beat against one another in the wind, and the faded leaves fluttered down into the muddy water. Here and there stood a small clump of dwarflike pines, a resting-place for crows which, scared up by the carriage, flew with loud screams over the heads of the travellers. No house was to be seen on the road, no pedestrian, and no vehicle.

Key to Exercise 50

„Wie heißt er?"

„Bingley."

„Iſt er verheiratet oder unverheiratet?"

„Ach natürlich unverheiratet, mein Lieber."

„Er iſt ein unverheirateter Mann von großem Vermögen," fuhr Frau Bennet fort, „und hat jährlich vier bis fünf tauſend Pfund Sterling Einkommen. Wie ſchön für unſere Töchter."

„Wie ſo? Wie kann es ſie berühren?"

„Mein lieber Bennet," antwortete ſeine Frau, „wie kannſt du nur mich ſo ärgern? Du mußt wiſſen, daß ich daran denke daß er eine von ihnen heiratet."

„Wird er ſich zu dem Zweck hier niederlaſſen?"

„Zweck! Unſinn! Wie kannſt du ſo reden? Aber es iſt höchſt wahrſcheinlich, daß er ſich in eine von ihnen verliebt, und darum mußt du ihn beſuchen ſo bald er herkommt."

„Ich verſichere dich, daß ich mich dazu nicht verpflichte."

„Aber bedenke deine Töchter. Denke nur was das für eine gute Partie für eine von ihnen wäre. Sir William und Lady Lucas haben ſich nur aus dieſem Grunde entſchloſſen hinzugehen, denn im Allgemeinen, wie du weißt, beſuchen ſie keine neuen Nachbaren."

M. A. L.

RUSSIAN—XII

The Adjective

124. The Russian Adjectives are classified into Qualifying and Relative, the first denoting the state of an object, and the second mostly its origin or derivation.

Examples of Qualifying Adjectives: Ста́рый, *old;* Молодо́й, *young;* Хоро́шій, *good, perfect;* Плохо́й, *bad, imperfect;* Си́ній, *blue.*

Examples of Relative Adjectives: Деревя́нный, *wooden;* Золото́й, *golden;* Ли́сій, *of a fox;* Челове́ческій, *human;* Оте́ческій, *paternal;* О́тцевъ, *the father's.*

125. The Qualifying Adjectives have three degrees of comparison; the Relative have none. Examples:

Ста́рый, *old;* Старе́е, *older;* Старе́йшій, *the oldest.*
Си́ній, *blue;* Синѣе, *more blue;* Синѣйшій, *the most blue.*

126. The endings of the Adjectives are as follows:

	Sing.	*Plur.*
Masculine	-ый, -ой, -ій, -ъ,	-ые, -іе, -ьи, -ы.
Feminine	-ая, -яя, -ья, -а,	-ыя, -ія, -ьи, -ы.
Neuter	-ое, -ее, -ье, -о,	-ыя, -ія, -ьи -ы.

For the declensions of the adjectives given as examples below see Tables K, L, and M on page 33.

127. According to column 1 in Tables K, L, and M, on p. 33, are declined all Adjectives having the hard ending -ый in Nominative Masculine Singular.

128. Like column 2 are declined the Adjectives with the ending -ой in Nominative Masculine Singular.

129. As column 3 are declined the Adjectives with the endings -гій -кій -хій. Examples:

Упру́гій, *flexible;* Кре́пкій, *strong;* Ти́хій, *quiet, calm, smooth.*

130. As column 4 are declined the Adjectives with the endings -ій (soft) in Masculine Singular. Example: Тепе́решній, *of the present time.*

131. After column 5 are declined the Adjectives with the endings -жій, -чій, -шій, -щій, in Masculine Singular. Examples:

Ры́жій, *red-haired;* Жгу́чій, *burning;* Хоро́шій, *good, nice;* То́щій, *lean, lank, fasting.*

132. After column 6 are declined the Adjectives denoting derivation from animals. Examples:

Оле́ній рогъ, *a stag's horn;* Коро́вье молоко́, *the cow's milk;* Ли́сій мѣхъ, *a fox-skin;* Воло́вья шку́ра, *a bull's hide;* Медве́жья шу́ба, *a bearskin coat.*

133. According to column 7 are declined Adjectives denoting human relationship. Examples:

О́тцевъ домъ, *the father's house;* Де́дово имѣніе, *the grandfather's estate;* Бра́тнинъ магази́нъ, *the brother's shop.*

134. The Adjectives usually precede the Nouns and coincide with them in gender, number, and case.

135. Any other part of speech with an Adjective ending is declined like an Adjective. Examples:

Портно́й, *a tailor;* Ни́щій, *a beggar;* Управля́ющій, *a manager;* Кото́рый, *which;* Таково́й, *such;* Второ́й, *the second;* Деся́тый, *the tenth.*

Examples.

English	*Mas. Sing.*	*Mas. Plur.*	*Fem. Sing.*	*Fem. Plur.*	*Neut. Sing.*	*Neut. Plur.*
White	Бѣлый	Бѣлые	Бѣлая	Бѣлыя	Бѣлое	Бѣлыя
Golden	Золото́й	Золоты́е	Золота́я	Золоты́я	Золото́е	Золоты́я
Long	До́лгій	До́лгіе	До́лгая	До́лгія	До́лгое	До́лгія
Early	Ра́нній	Ра́нніе	Ра́нняя	Ра́нніе	Ра́ннее	Ра́нніе
Working	Рабо́чій	Рабо́чіе	Рабо́чая	Рабо́чія	Рабо́чее	Рабо́чія
Of a goat	Ко́зій	Ко́зьи	Ко́зья	Ко́зьи	Ко́зье	Ко́зьи
The uncle's	Дя́динъ	Дя́дины	Дя́дина	Дя́дины	Дя́дино	Дя́дины.

136. TABLE N.—Conjugation of Irregular Verbs (*Continued*).

Note: All the Verbs of this table are Perfective, and therefore have no Present tense.

Infinitive	Past Tense				Imperative 2nd Person		Future Tense					
	Sing.			*Plur.*			*Sing.*			*Plur.*		
	Mas.	*Fem.*	*Neut.*	*All genders*	*Sing.*	*Plur.*	Я	Ты	Онъ Она Оно	Мы	Вы	Они Онѣ Они
Пріобрѣсть *To acquire*	Пріобрѣлъ	Пріобрѣла	Пріобрѣло	Пріобрѣли	Пріобрѣти	-те	Пріобрѣту́	пріобрѣтёшь	пріобрѣтётъ	Пріорѣтёмъ	пріобрѣтёте	пріобрѣту́тъ
Прочéсть *To read through*	Прочёлъ	Прочла́	Прочло́	Прочли́	Прочти́	прочтитк?	Прочту́	прочтёшь	прочтётъ	Прочтёмъ	прочтёте	прочту́тъ
Нача́ть *To begin*	На́чалъ	Начала́	На́чало	На́чали	Начни́	начни́те	Начну́	начнёшь	начнётъ	Начнёмъ	начнёте	начну́тъ
Взять *To take*	Взялъ	Взяла́	Взяло́	Взяли́	Возьми́	-те	Возьму́	возьмёшь	возьмётъ	Возьмёмъ	возьмёте	возьму́тъ
Стать *To become* *To start*	Сталъ	Ста́ла	Ста́ло	Ста́ли	Стань	ста́ньте	Ста́ну	ста́нешь	ста́нетъ	Ста́немъ	ста́нете	ста́нутъ
Дѣть *To put*	Дѣлъ	Дѣла	Дѣло	Дѣли	Дѣнь	дѣньте	Дѣну	дѣнешь	дѣнетъ	Дѣнемъ	дѣнете	дѣнутъ
Дать *To give*	Далъ	Дала́	Да́ло	Да́ли	Да́й	да́йте	Дамъ	дашь	дастъ	Дади́мъ	дали́те	даду́тъ
Сѣсть *To sit down*	Сѣлъ	Сѣла	Сѣло	Сѣли	Ся́дь	ся́дьте	Ся́ду	ся́дешь	ся́детъ	Ся́демъ	ся́дете	ся́дутъ
Пасть *To fall*	Палъ	Па́ла	Па́ло	Па́ли	Пади́	пади́те	Паду́	падёшь	падётъ	Падёмъ	падёте	паду́тъ
Лечь *To lie down*	Лёгъ	Легла́	Легло́	Легли́	Лягъ	ля́гте	Ля́гу	ля́жешь	ля́жетъ	Ля́жемъ	ля́жете	ля́гутъ
Заня́ть *To borrow*	За́нялъ	Заняла́	За́няло	За́няли	Займи́	займи́те	Займу́	займёшь	займётъ	Займёмъ	займёте	займу́тъ
Наня́ть *To hire*	На́нялъ	Наняла́	На́няло	На́няли	Найми́	найми́те	Найму́	наймёшь	наймётъ	Наймёмъ	наймёте	найму́тъ
Поня́ть *To understand*	По́нялъ	Поняла́	По́няло	По́няли	Пойми́	пойми́те	Пойму́	поймёшь	поймётъ	Поймёмъ	поймёте	пойму́тъ
Перея́ть *To take over*	Перея́лъ	Перенялá	Перея́ло	Перея́ли	Перейми́	-те	Перейму́	переймёшь	переймётъ	Переймёмъ	переймёте	переймýтъ
Приня́ть *To receive* *To accept*	При́нялъ	Приняла́	При́няло	При́няли	Прими́	прими́те	Приму́	при́мешь	при́метъ	При́мемъ	при́мете	при́мутъ

137. **TABLE K.—Declension of Masculine Adjectives.**

	1	2	3	4	5	6	7
	Бѣ́лый	Золото́й	До́лгій	Ра́нній	Рабо́чій	Ко́зій	Дя́динъ
				Sing.			
Nom. . .	Бѣ́лый	Золото́й	До́лгій	Ра́нній	Рабо́чій	Ко́зій	Дя́динъ
Gen. . .	Бѣ́лаго	Золота́го	До́лгаго	Ра́няго	Рабо́чаго	Ко́зьяго	Дя́дина
Dat. . .	Бѣ́лому	Золото́му	До́лгому	Ра́ннему	Рабо́чему	Ко́зьему	Дя́дину
Accus. . .		Living as Genitive and inanimate as Nominative.					
Instru. . .	Бѣ́лымъ	Золоты́мъ	До́лгимъ	Ра́ннимъ	Рабо́чимъ	Ко́зьимъ	Дя́динымъ
Prepos. . .	О бѣ́ломъ	О золото́мъ	О до́лгомъ	О ра́ннемъ	О рабо́чемъ	О ко́зьемъ	О дя́диномъ
				Plur.			
Nom. . .	Бѣ́лые	Золоты́е	До́лгіе	Ра́нніе	Рабо́чіе	Ко́зьи	Дя́дины
Gen. . .	Бѣ́лыхъ	Золоты́хъ	До́лгихъ	Ра́нніхъ	Рабо́чихъ	Ко́зьихъ	Дя́диныхъ
Dat. . .	Бѣ́лымъ	Золоты́мъ	До́лгимъ	Ра́ннимъ	Рабо́чимъ	Ко́зьимъ	Дя́динымъ
Accus. . .		Living as Genitive and inanimate as Nominative.					
Instru. . .	Бѣ́лыми	Золоты́ми	До́лгими	Ра́нними	Рабо́чими	Ко́зьими	Дя́дины
Prepos. . .	О бѣ́лыхъ	О золоты́хъ	О до́лгихъ	О ра́нніхъ	О рабо́чихъ	О ко́зьихъ	О дя́диныхъ

138. **TABLE L.—Declension of Feminine Adjectives.**

	1	2	3	4	5	6	7
	Бѣ́лая	Золота́я	До́лгая	Ра́нняя	Рабо́чая	Ко́зья	Дя́дина
				Sing.			
Nom. . .	Бѣ́лая	Золота́я	До́лгая	Ра́нняя	Рабо́чая	Ко́зья	Дя́дина
Gen. . .	Бѣ́лой	Золото́й	До́лгой	Ра́шней	Рабо́чей	Ко́зьей	Дя́диной
Dat. . .	Бѣ́лой	Золото́й	До́лгой	Ра́нней	Рабо́чей	Ко́зьей	Дя́диной
Accus. . .	Бѣ́лую	Золоту́ю	До́лгую	Ра́ннюю	Рабо́чую	Ко́зью	Дя́дину
Instru. . .	Бѣ́лою	Золото́ю	До́лгою	Ра́ннею	Рабо́чею	Ко́зьею	Дя́диной
Prepos. . .	О бѣ́лой	О золото́й	О до́лгой	О ра́нней	О рабо́чей	О ко́зьей	О дя́диной
				Plur.			
Nom. . .	Бѣ́лыя	Золоты́я	До́лгія	Ра́ннія	Рабо́чія	Ко́зьи	Дя́дины
Gen. . .	Бѣ́лыхъ	Золоты́хъ	До́лгихъ	Ра́нніхъ	Рабо́чихъ	Ко́зьихъ	Дя́диныхъ
Dat. . .	Бѣ́лымъ	Золоты́мъ	До́лгимъ	Ра́шнимъ	Рабо́чимъ	Ко́зьимъ	Дя́динымъ
Accus. . .		Living as Genitive and inanimate as Nominative.					
Instru. . .	Бѣ́лыми	Золоты́ми	До́лгими	Ра́нними	Рабо́чими	Ко́зьими	Дя́дины
Prepos. . .	О бѣ́лыхъ	О золоты́хъ	О до́лгихъ	О ра́нніхъ	О рабо́чихъ	О ко́зьихъ	О дя́диныхъ

139. **TABLE M.—Declension of Neuter Adjectives.**

	1	2	3	4	5	6	7
	Бѣ́лое	Золото́е	До́лгое	Ра́ннее	Рабо́чее	Ко́зье	Дя́дино
				Sing.			
Nom. . .	Бѣ́лое	Золото́е	До́лгое	Ра́ннее	Рабо́чее	Ко́зье	Дя́дино
Gen. . .	Бѣ́лаго	Золота́го	До́лгаго	Ра́няго	Рабо́чаго	Ко́зьяго	Дя́дина
Dat. . .	Бѣ́лому	Золото́му	До́лгому	Ра́ннему	Рабо́чему	Ко́зьему	Дя́дину
Accus. . .	Бѣ́лое	Золото́е	До́лгое	Ра́ннее	Рабо́чее	Ко́зье	Дя́дино
Instru. . .	Бѣ́лымъ	Золоты́мъ	До́лгимъ	Ра́ннимъ	Рабо́чимъ	Ко́зьимъ	Дя́динымъ
Prepos. . .	О бѣ́ломъ	О золото́мъ	О до́лгомъ	О ра́ннемъ	О рабо́чемъ	О ко́зьемъ	О дя́диномъ
				Plur.			
Nom. . .	Бѣ́лыя	Золоты́я	До́лгія	Ра́ннія	Рабо́чія	Ко́зьи	Дя́дины
Gen. . .	Бѣ́лыхъ	Золоты́хъ	До́лгихъ	Ра́нніхъ	Рабо́чихъ	Ко́зьихъ	Дя́диныхъ
Dat. . .	Бѣ́лымъ	Золоты́мъ	До́лгимъ	Ра́шнимъ	Рабо́чимъ	Ко́зьимъ	Дя́динымъ
Accus. . .	Бѣ́лыя	Золоты́я	До́лгія	Ра́ннія	Рабо́чія	Ко́зьи	Дя́дины
Instru. . .	Бѣ́лыми	Золоты́ми	До́лгими	Ра́нними	Рабо́чими	Ко́зьими	Дя́дины
Prepos. . .	О бѣ́лыхъ	О золоты́хъ	О до́лгихъ	О ра́нніхъ	О рабо́чихъ	О ко́зьихъ	О дя́диныхъ

140. Like пріобрѣсть is conjugated the Verb изобрѣсть, *to invent*.

141. Like прочéсть are conjugated the following :

Почéсть, *to regard as, take for ;* Перечéсть, *to read over again ;* Счесть, *to calculate, reckon up ;* Вы́честь, *to subtract ;* Отчéсть, *to deduct, take off a sum ;* Учéсть, *to discount* (bills) ; Зачéсть, *to take to the account* (book to the account).

142. Like стать are conjugated the following :

Встать, *to get up ;* Приста́ть, *to land, join, insist upon ;* Наста́ть, *to come on, to press somebody with a task ;* Переста́ть, *to give up, stop, cease ;* Отста́ть, *to stay away, disjoin oneself, stop behind ;* Уста́ть, *to get tired.*

143. Like дѣть are conjugated the following :

Одѣть and Надѣть, *to put on, dress ;* Передѣть, *to change a garment.*

144. Like дать are conjugated the following :

Прида́ть, *to add, attach ;* Прода́ть, *to sell ;* Переда́ть, *to hand over, convey, transmit ;* Вы́дать, *to hand out ;* Отда́ть, *to give away, return, restore ;* Сдать, *to deliver* (goods), *render* (account, report).

145. Like пасть are conjugated :

Пропа́сть, *to perish, get lost ;* Упа́сть, *to fall down ;* Напа́сть, *to fall on, assail ;* Впасть, *to fall in.*

VOCABULARY

NOTE.—The student can now easily dispense with the English figured pronunciation of the Russian words, and this will be discarded for the remainder of the Course.]

Дѣдушкинъ, *the grandfather's.*
Желѣзная торго́вля, *an ironmongery shop.*
Наконе́цъ, *at last.*
Пасть (P.) ду́хомъ, *to be disheartened.*
Кру́пный, *huge.*
Ко́жанный портфе́ль, *the leather portfolio.*
Дешёвый това́ръ, *cheap ware, goods.*
Интересова́ться (Imp.) (with Instrumental), *to be interested in.*
Предме́тъ, *object, article.*
Жела́ть (Imp.), *to wish, desire.*
Поздравля́ть (Imp.), *to congratulate.*
Но́вый Годъ, *the New Year.*
Никаки́хъ, *no, none.*
Заплати́ть (P.), *to pay.*
Отъ кого́, *from whom.*
Э́ту, *this.*
Цѣпо́чка, *a chain.*
Но́вый магази́нъ, *the new shop.*
Служи́тель, *an employee.*
Лу́чше (followed by Genitive = better than), *is better than.*
Дово́льны ли Вы? *are you satisfied?*
Высоко́, *highly.*
Цѣни́ть (Imp.), *to appreciate.*
Большо́й, *great.*
О́пытность въ дѣла́хъ, *business experience.*
Толкъ, *sense* (meaning "head or tail").
Въ Ва́шихъ (plural), *in your.*
Торго́вый расхо́дъ, *a trading expense.*
Сове́товать (Imp.), *to advise.*
Ввести́ (P.), *to introduce.*
Строжа́йшая эконо́мія, *the strictest economy.*
И́скреннее увѣре́ніе, *sincere assurance of.*
То́чное выполне́ніе, *exact execution.*
Въ ожида́ніи, *anticipating.*
Уважа́емое извѣстіе, *esteemed news.*
Пребыва́ть (Iter.), *to remain.*
Съ соверше́ннымъ почте́ніемъ, *yours faithfully.*
Шерстяна́я мате́рія, *woollen stuff.*
Ко́зій во́лосъ, *goat's hair.*
Ка́менный домъ, *stone house.*
Занима́ть (Imp.), *to employ.*
Пако́вочное отдѣле́ніе, *the packing room.*
Серебря́ное изде́ліе, *silver article goods.*
Бичёвка, *string.*
Посы́лка, *a parcel.*
Недово́ленъ, *not satisfied.*
Счётъ, *account, invoice.*
Тамъ, *there.*
Наста́вить (P.), *to put on.*
Чрезме́рная цѣна́, *exorbitant price.*

Exercise 20

1. Я перенялъ дѣдушкину желѣзную торго́влю.
2. Когда́ Вы мнѣ дади́те наконе́цъ зака́зъ?
3. Не падите ду́хомъ : я дамъ вско́рѣ кру́пный зака́зъ.
4. Мой ко́жанный портфе́ль пропа́лъ.
5. Имѣю для Васъ дёшевый това́ръ.
6. Я не интересу́юсь дёшевыми предме́тами.
7. Жела́ю купи́ть пи́сью шу́бу.
8. Поздравля́ю Васъ съ Но́вымъ Го́домъ.
9. Куда́ Вы дѣли ру́сскія пи́сьма?
10. Я не ви́дѣлъ никаки́хъ ру́сскихъ пи́семъ.
11. Ско́лько Вы заплати́ли за золоты́е часы́?
12. Отъ кого́ Вы пріобрѣли́ э́ту золоту́ю цѣпо́чку?
13. Я её (it) купи́лъ въ но́вомъ магази́нѣ.
14. Ста́рый служи́тель лу́чше двухъ молоды́хъ.
15. Дово́льны ли Вы но́вымъ управля́ющимъ?
16. Я высо́ко цѣню́ его́ большу́ю о́пытность въ дѣла́хъ.
17. Я не понима́ю то́лка въ Ва́шихъ торговы́хъ расхо́дахъ.
18. Сове́тую Вамъ ввести строжа́йшую эконо́мію.
19. Приме́те моё и́скреннее увѣре́ніе въ то́чномъ выполне́ніи Ва́шего зака́за.
20. Въ ожида́ніи Ва́шихъ уважа́емыхъ извѣстій пребыва́ю Съ соверше́ннымъ почте́ніемъ.

Exercise 21

[*Note.*—Words not found in the Vocabulary are in the text of this lesson or have been supplied previously.]

1. The long days have come (on = настать).
2. I am looking for (искать) white woollen stuffs.
3. This (э́та) stuff is made (сдѣлана) of (изъ) goat's hair.
4. I live in the uncle's stone house.
5. We have been working since (съ) the early morning (у́тро).
6. How many (ско́лько) working men are you employing in the packing room?
7. We deal in gold and silver articles.
8. Take strong strings for these (для э́тихъ) parcels.
9. I am not satisfied with the present invoice.
10. You have put on there exorbitant prices.

A. C.

Continued from Vol. III., page 489.

GEOGRAPHY:

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NORTH AMERICA.—V

THE Republic of Mexico occupies the somewhat horn-shaped southern extremity of the North American continent, being bounded on the north by an irregular line separating it from the United States and on the south by the Republic of Guatemala and the British Colony of Honduras. At one time the northern extremity of Mexico was indefinite and comprised an area now incorporated in the United States considerably greater than the whole present extent of its territory; but since the cession in 1848-53 of what are now the states of Arizona, New Mexico, California, Nevada, Utah and Wyoming, the area of the Mexican Republic is about 770,000 square miles. The population is probably cons derably over fifteen millions, but accurate figures are not obtainable.

The Plateau of Mexico

The greater part of Mexico—in fact all of it north of the isthmus of Tehuantepec, is a great plateau; the largest in the globe after those of Tibet and the Bolivian Andes. This plateau is enclosed by the two ranges of the Sierra Madre Mountains—the Sierra Madre Oriental and the Sierra Madre Occidental which converge in the state of Oajaca. Both ranges run more or less parallel to the sea at distances varying from ten to 100 miles. The Pacific range is the higher and has a mean elevation of from ten to 12,000 feet for a distance of 2,000 miles far into the United States (Arizona). Besides these ranges there is the Sierra de la Giganta, the backbone of the peninsula of Lower California which has a mean height of some 4,000 feet, falling precipitously into the Gulf of California.

The plateau of Central Mexico rises in terraces from the state of Oajaca to an altitude of about 7,500 feet and maintains an almost uniform elevation for well over 1,000 miles to the Rio Grande del Norte. The plateau is broken here and there by great fissures descending as much as 1,000 feet which have been formed by the action of running waters. The scenery in the mountains especially in the western range is remarkably beautiful, and is in parts varied by lakes, the largest of which is Lake Chapala, 60 miles long and of surpassing loveliness.

Amazing Mineral Wealth

The mineral wealth of these mountains is amazing, the veins of ore containing silver, often in large nuggets of remarkable purity, being extremely numerous. Probably one-third of the total world production of the precious metal is derived from the republic. Besides silver, but less commercially developed, are found gold, copper, iron ores of great purity, and coal.

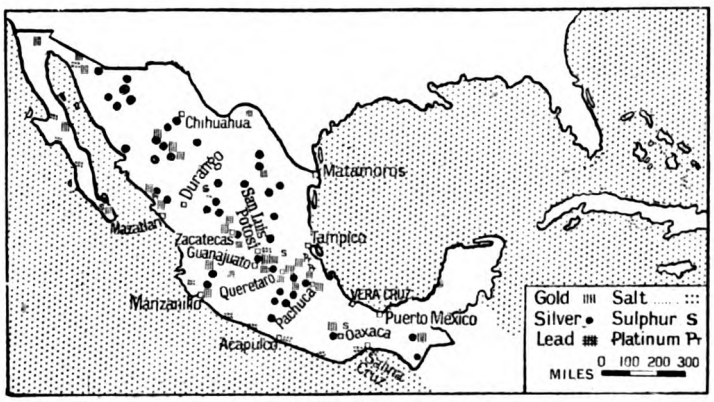
The highest mountains of Mexico are Popocatepetl, 17,880 feet high, and Orizaba, 18,200 feet, than which Mt. McKinley only on the continent of North America is higher. Both these mountains are volcanic cones of great regularity and beauty, and both (though comparatively recently active) are now quiescent.

Owing to the nearness of the Sierra Madre ranges to the sea there are few rivers of any importance in Mexico, the largest being the Lerma which flows into Lake Chapala and, leaving it as the Rio Grande de Santiago, flows into the Pacific after a course of 620 miles.

The climate of Mexico is much more dependent on altitude than on latitude. The climate of Mexico City, for instance, standing over 7,000 feet above sea level, is more pleasant than that of New York having cooler summers and warmer winters, though situated perhaps 1,500 miles nearer to the Equator. So much is this the case that Mexico has been divided as regards climate into three zones: the Tierra Caliente (hot zone), from sea level to 3,000 feet, the Tierra Templada (temperate zone), from 3,000 to

5,000 feet, and the Tierra Fria (cool zone) from 7,000 to 9,000 feet. The Tierra Fria is really a temperate zone with a mean temperature of about 65° Fahr., and this is the most thickly populated portion of the republic with the healthiest and most pleasant climate.

The vegetation of Mexico follows the climate zones, ranging from the tropical products of the low-lying regions where coco-nut palms flourish, to the wheat and maize fields of the Tierra Fria. Among the plants of commercial use are coffee, sugar cane, tobacco, cotton, cocoa, wheat, maize and pineapple. A variety of aloe provides from its stringy fibres the material known as "hennequin" or Sisal hemp, from the port of Yucatan whence it is largely shipped. The plant is principally grown on the Yucatan peninsula, as it flourishes best in a dry and stony soil.



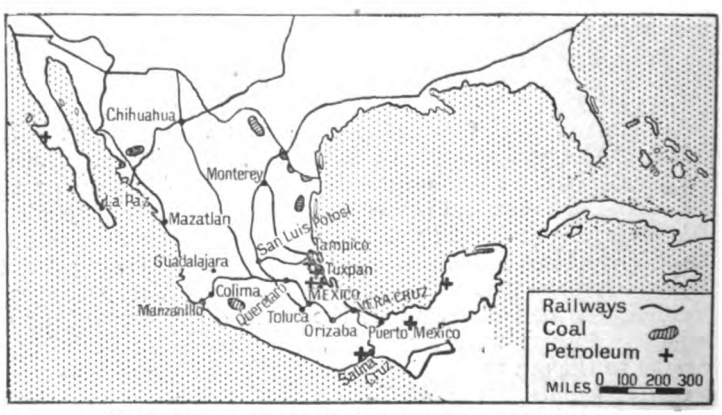
MINERAL RESOURCES OF MEXICO.

The fauna of Mexico is remarkably rich and is intermediate in type between the North American continent generally and South America. Mention may be made of a curious amphibian known as the Axolotl, a kind of lizard provided with gills for breathing in water. The bird also known as the Quetzal, whose plumage was, in the time of the Aztecs, exclusively reserved for royalty, is found here as also in the central American states.

The peninsulas of Yucatan on the south-east and Lower California on the west are very different in many ways from the main portion of the country. The former is a rather bare and monotonous limestone area of low elevation; the latter a mountainous and almost rainless strip of land, well supplied, however, with mineral wealth.

The capital and largest city in the republic is Mexico City, situated in the centre of the Anahuac tableland and enjoying a climate which is described as "perpetual spring." It is a very handsome city with fine streets and buildings and the most wonderful cathedral in the New World. The surroundings are delightful, the scenery, embracing as it does the great mountains of Popocatepetl and Ixtaccihuatl, being overwhelmingly majestic and sublime. The population is about 470,000. Other important cities are Puebla, Leon, Vera Cruz and Guadalajara. The unhealthy towns of Vera Cruz and Tampico are the chief ports on the Gulf; and Acapulco on the Pacific coast has a good natural harbour.

Mexico has about 16,000 miles of railways, four lines connecting it with the United States, to which it chiefly exports its agricultural and mineral products.



RAILWAYS AND FUEL RESOURCES OF MEXICO.

By far the most important article of commerce is silver, but there is considerable trade in coffee, hennequin, gold, cattle, hides and tobacco, etc., mostly conducted with the United States.

The climate of Mexico with its hot, temperate and cool zones make the country well suited to agriculture.

The soil is very rich and there are millions of acres of virgin soil, and much more could be got out of the territory already cultivated

Photo: by permission of the National Railways of Mexico.

THE PYRAMID OF THE SUN AT TEOTIHUACAN.

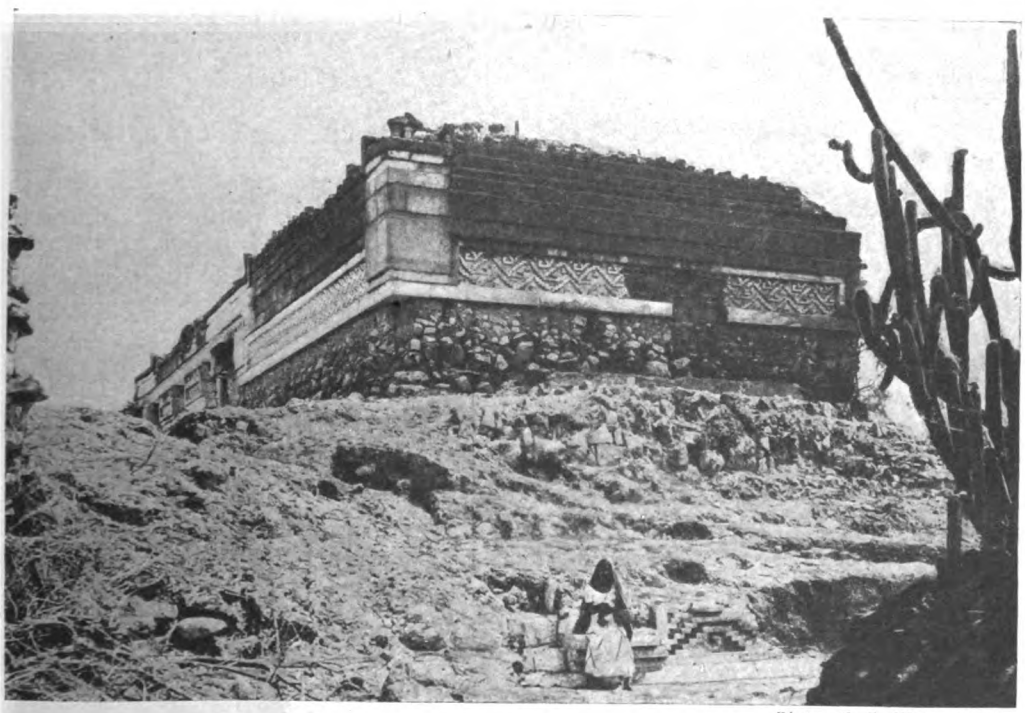


Photo: C. B. Waite, Mexico.

ONE OF THE WONDERFUL RUINS AT MITLA.

Relics of a forgotten Aztec civilization that at some remote period flourished in Mexico.

if modern agricultural methods were in general use.

Mining is the chief industry and it is carried on in a large number of the States. The chief ore is silver which is found either alone or in combination with other minerals.

The output of sugar and molasses is not inconsiderable ; and the output of petroleum has rapidly increased from year to year.

Mexico

The federal republic of Mexico consists of 31 States and Territories enjoying a degree of self-government but united for purposes of national welfare. The inhabitants are composed of Europeans about 20 per cent., 40 per cent. half-breeds, and 40 per cent. pure " Indians."

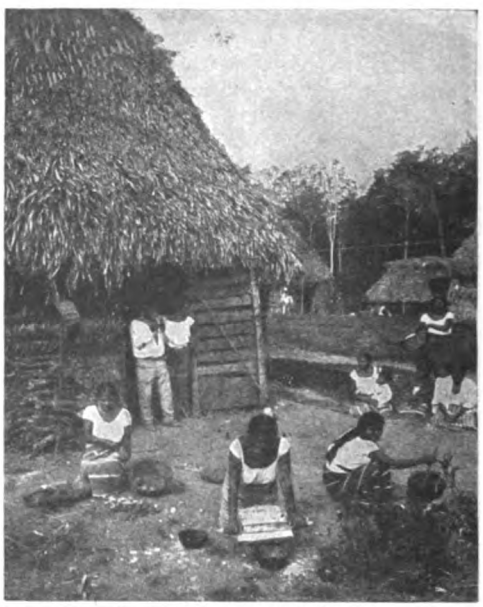
Our account of the North American continent will not be complete without some reference to the aboriginal inhabitants known as " Indians " or " Red Indians " from the mistaken idea of the original discoverers of the country that they had reached India by a western route.

Photos: Underwood and Underwood.

Indian Types: of the Arizona district and—

These are now found in Mexico and in certain areas of the United States and Canada. At the time of the discovery of America they were much more numerous than they are at present, but many were killed in the various wars with the white settlers, some have intermarried, and generally, in contact with civilised races the uncivilised races have tended to die out.

The degree of civilisation attained by these native races varied very much ; some of them, such as the Aztecs of Mexico, having attained a very high standard ; and the ruins of their buildings, cities and works of engineering are even now among the most



—of the Tehuantepec Isthmus.

wonderful and interesting sights of the continent, especially in Mexico.

To-day the natives are usually classified on a linguistic basis in different " stocks," subdivided into branches or families, which often constitute separate and important " nations " among the tribes. Such stocks are, e.g. the Eskimoan, Algonquinian, Iroquoian, Siouan, Maya-Quichean, etc., inhabiting different portions of the continent.

Native Tribes

Such names as Shawnees, Delawares, Micmacs, Cheyennes, for instance, are families of the Algonquinian stock. Along the Pacific coast of North America the number of stocks are very crowded together, whereas east of the Rockies there are comparatively few and these have ranged over vast areas.

It is generally supposed that originally these inhabitants came from Asia and Europe by way of the Behring Straits possibly as far back as pre-glacial times. This theory, however, is open to question. Further researches should be undertaken by students. For the whole subject is full of difficulties, and the conclusions are very much disputed by different authorities. C. J. S.

Continued from Vol. III., page 493.

MATHEMATICS:

Contributor: — ARITHMETIC, ALGEBRA, GEOMETRY, CO-ORDINATE GEOMETRY, TRIGONOMETRY, MECHANICS, MENSURATION, ETC.

(M. A. Lewenz, M.A.[Lond.]).

ALGEBRA.—XXIV

145. Properties of the Coefficients of a Binomial Expansion.

$(1+x)^n = 1 + {}_nC_1\,x + {}_nC_2\,x^2 + \ldots + {}_nC_r\,x^r + \ldots + {}_nC_{n-1}\,x^{n-1} + x^n$

$= {}_nC_0 + {}_nC_1\,x + {}_nC_2\,x^2 + \ldots + {}_nC_r\,x^r + \ldots + {}_nC_{n-1}\,x^{n-1} + {}_nC_n\,x$

on the assumption we made before that ${}_nC_0 = \frac{1}{0!} = 1$ and ${}_nC_n = \frac{1}{0!} = 1$

(i) In the above put $x = 1$.

Then

$2^n = {}_nC_0 + {}_nC_1 + {}_nC_2 + \ldots + {}_nC_r + \ldots + {}_nC_{n-1} + {}_nC_2$

(ii) in the above put $x = -1$

Then

$0 = {}_nC_0 - {}_nC_r + {}_nC_2 - \ldots + (-1)^r\,{}_nC_r + \ldots + (-1)^{n-1}\,{}_nC_{n-1} + (-1)^n\,{}_nC_n$

Hence we see that

(i) the sum of the coefficients of the even powers of x plus the sum of the coefficients of the odd powers of $x = 2^n$

(ii) the sum of the coefficients of the even powers of x = the sum of the coefficients of the odd powers of $x = \frac{1}{2}$ of $2^n = 2^{n-1}$

(iii) To sum the squares of these coefficients.

$\because {}_nC_r = {}_nC_{n-r}$ we have

$(1+x)^n = 1 + {}_nC_{n-1}\,x + {}_nC_{n-2}\,x + \ldots + {}_nC_{n-r}\,x^r + \ldots + {}_nC_1\,x^{n-1} + x^n$

but $(1+x)^n = 1 + {}_nC_1\,x + {}_nC_2\,x^2 + \ldots + {}_nC_r\,x^r + \ldots + {}_nC_{n-1}\,x^{n-1} + x^n$

Multiply the terms of the two series, and collect the terms in the product containing x^n

These are: $1 \cdot x^n + {}_nC_1\,x\,({}_nC_1\,x^{n-1}) + {}_nC_2\,x^2\,({}_nC_2\,x^{n-2}) + \ldots + {}_nC_r\,x^r\,({}_nC_r\,x^{n-r}) + \ldots + {}_nC_{n-1}\,x^{n-1}\,({}_nC_{n-1}\,x) + x^n$.

$\therefore$ coefficient of x^n in $(1+x)^n \times (1+x)^n$ i.e. in $(1+x)^{2n}$

$= 1^2 + {}_nC_1{}^2 + {}_nC_2{}^2 + \ldots + {}_nC_r{}^2 + \ldots + {}_nC_{n-1}{}^2 + 1^2$

but the coefficient of x^n in the expansion of $(1+x)^{2n} = \frac{2n!}{n!\,n!}$

$\therefore$ the sum of the squares of the coefficients of x in the expansion of $(1+x)^n = \frac{2n!}{n!\,n!}$

(iv) $(1+x)^n = 1 + {}_nC_1\,x + {}_nC_2\,x^2 + \ldots + {}_nC_r\,x^r + \ldots + {}_nC_{n-1}\,x^{n-1} + x^n$.

$(1-x)^n = 1 + {}_nC_{n-1}\,x + {}_nC_{n-2}\,x^2 - \ldots\ldots + (-1)^r\,{}_nC_{n-r}\,x^r + \ldots\ldots + (-1)^{n-1}\,{}_nC_1\,x^{n-1} + (-1)^n\,x^n$.

Multiply the terms of the two series and collect the terms of the product containing x^n

These are: $1^2 - ({}_nC_{n-1})^2 + ({}_nC_{n-2})^2 - \ldots\ldots + (-1)^{n-r}\,({}_nC_r)^2 + \ldots\ldots + (-1)^{n-2}\,({}_nC_2)^2 + (-1)^{n-1}\,({}_nC_1)^2 + (-1)^n\,1^2$

and the sum of these is the coefficient of x^n in $(1-x^2)^n$.

Now if n be odd, x^n does not occur in $(1-x^2)^n$, and then the above series $= 0$

But if n be even, we have the following:

In the expansion of $(1-x^2)^n$, $T_{r+1} = {}_nC_r\,(-x^2)^r$ since n is even, let $n = 2r$

Then $T_{\frac{n}{2}+1} = {}_nC_{\frac{n}{2}}\,(-x^2)^{\frac{n}{2}}$

$\therefore$ coefficient of x^n $(1-x^2)^n$ if n be even is

$(-1)^{\frac{n}{2}}\,\frac{n!}{\frac{n}{2}!\,\frac{n}{2}!}$.

Hence if n be even, the sum of the above series $= (-1)^{\frac{n}{2}}\,\frac{n!}{\frac{n}{2}!\,\frac{n}{2}!}$

Examples:—

(1) Show that ${}_nC_0 - 2\,{}_nC_1 + 3\,{}_nC_2 \ldots\ldots + (-1)^n\,(n+1)\,{}_nC_n = 0$

The series $= 1 - 2n + \frac{3n\,(n-1)}{1.2} - \frac{4n\,(n-1)\,(n-2)}{1.2.3} + \ldots\ldots$

$$+ (-1)^r \frac{(r+1)n!}{r!\,(n-r)!} + \ldots\ldots + (-1)^n (n+1)$$
$$= 1 - n + \frac{n(n-1)}{1\cdot 2} - \frac{n(n-1)(n-2)}{1\cdot 2\cdot 3}$$
$$+ \ldots\ldots + (-1)^r \frac{n!}{r!\,(n-r)!} + \ldots + (-1)^n$$
$$-n + \frac{2n(n-1)}{1\cdot 2} - \frac{3n(n-1)(n-2)}{1\cdot 2\cdot 3} + \ldots$$
$$+ (-1)^r r\cdot\frac{n!}{r!\,(n-r)!} + \ldots + (-1)^n n$$
$$= 1 - {}_nC_1 + {}_nC_2 - {}_nC_3 + \ldots\ldots + (-1)^r {}_nC_r$$
$$+ \ldots\ldots + (-1)^n$$
$$- n\{1 - {}_{n-1}C_1 + {}_{n-1}C_2 + \ldots\ldots\ldots$$
$$+ (-1)^{r-1} {}_{n-1}C_{r-1} + \ldots\ldots + (-1)^{n-1}\}$$
$$= 0 - n \times 0 = 0$$

(2) Prove that ${}_nC_2 + 2\,{}_nC_3 + 3\,{}_nC_4 + \ldots + (n-1)\,{}_nC_n = 1 + (n-2)\,2^{n-1}$

$$T_{r-1} = (r-1)\,{}_nC_r = (r-1)\frac{n!}{r!\,(n-r)!}$$
$$= \frac{r\,n!}{r!\,(n-r)!} - \frac{n!}{r!\,(n-r)!}$$
$$= \frac{n!}{(r-1)!\,(n-r)!} - {}_nC_r$$
$$= \frac{n(n-1)!}{(r-1)!\,(n-r)!} - {}_nC_r$$
$$= n\,{}_{n-1}C_{r-1} - {}_nC_r.$$

Hence putting in for successive values of r the series

$$= n\{{}_{n-1}C_1 + {}_{n-1}C_2 + {}_{n-1}C_3 + \ldots + {}_{n-1}C_{r-1} + \ldots + {}_{n-1}C_{n-1}\}$$
$$- \{{}_nC_2 + {}_nC_3 + {}_nC_4 + \ldots + {}_nC_r + \ldots + {}_nC_n\}$$
$$= n[(1+1)^{n-1} - 1] - [(1+1)^n - (1+n)]$$
$$= n\,2^{n-1} - n - 2^n + 1 + n = (n-2)\,2^{n-1} + 1$$

146. Multinomial Theorem.

The expansion of $(a+b+c+d+\ldots\ldots)^n$ can be found by means of the Binomial Theorem; for $(a+b+c+d+\ldots)^n = \{a + (b+c+d+\ldots)\}^n$ and the general term of this is ${}_nC_r\,a^r(b+c+d+\ldots)^{n-r}$

$$= \frac{n!}{r!\,(n-r)!}\,a^r(b+c+d+\ldots)^{n-r}$$

Similarly the general term in the expansion of $(b+c+d+\ldots)^{n-r}$ is $\frac{(n-r)!}{s!\,(n-r-s)!}\,b^s(c+d+\ldots)^{n-r-s}$

And by repeated application, the general term of $(a+b+c+d+\ldots)^n$

$$= \frac{n!}{r!\,(n-r)!} \times \frac{(n-r)!}{s!\,(n-r-s)!}$$
$$\times \frac{(n-r-s)!}{t!\,(n-r-s-t)!} \cdot\ldots\ldots a^r\,b^s\,c^t\ldots\ldots$$
$$= \frac{n!}{r!\,s!\,t!\ldots}\,a^r\,b^s\,c^t\ldots\ldots$$

where $r, s, t \ldots$ are each zero or a positive integer and $r+s+t+\ldots = n$.

Example:—

Find the coefficient of bcd^2 in the expansion of $(a+b+c+d)^4$

We have the term $\frac{4!}{1!\,1!\,2!}\,bcd^2$

$\therefore$ the coefficient $= 12$.

Similarly in the expansion of $(a + bx + cx^2 + dx^3 + \ldots)^n$ the general term is

$$\frac{n!}{r!\,s!\,t!\,w!\ldots\ldots}\,a^r(bx)^s\,(cx^2)^t\,(dx^3)^w\ldots\ldots$$
$$= \frac{n!}{r!\,s!\,t!\,w!\ldots\ldots}\,a^r\,b^s\,c^t\,d^w\ldots x^{s+2t+3w+\ldots}$$

Hence to find the coefficient of x^p in this expansion we must find the various sets of values of $r, s, t, w \ldots\ldots$ (where $r, s, t, w \ldots\ldots$ are zero or positive integers) which satisfy the equations

$r + s + t + w + \ldots\ldots = n$ (i)

$s + 2t + 3w + \ldots\ldots = p$ (ii)

Example:—

Find the coefficient of x^4 in the expansion of $(1 + x + x^2)^3$

The general term is $\frac{3!}{r!\,s!\,t!}\,1^r\,x^{s+2t}$

The terms required are those for which $s + 2t = 4$ and $r + s + t = 3$

Since r, s and t must be zero or positive integers the only possible sets of values are:

$r = 0,\ s = 2,\ t = 1$

$r = 1,\ s = 0,\ t = 2$

The corresponding coefficients are

$\frac{3!}{2!\,1!} = 3$ and $\frac{3!}{1!\,2!} = 3$

$\therefore$ the coefficient of x^4 in the expansion $= 3 + 3 = 6$.

Exercise 35

(1) Show that ${}_nC_1 - 2\,{}_nC_2 + 3\,{}_nC_3 - \ldots\ldots + (-1)^{n-1} n\,{}_nC_n = 0$.

(2) Show that $2\,{}_nC_0 + \frac{2^2\,{}_nC_1}{2} + \frac{2^3\,{}_nC_2}{3} + \frac{2^4\,{}_nC_3}{4} + \ldots\ldots\ldots + \frac{2^{n+1}\,{}_nC_n}{n+1} = \frac{3^{n+1}-1}{n+1}$.

(3) Find the coefficient of abc in $(a+b+c)^3$.

(4) Find the coefficients of a^2b^2 and $abcd$ in $(a+b+c+d)^4$.

(5) Find the coefficient of x^5 in $(1 + 2x + 3x^2)^4$.

(6) Find the coefficient of x^8 in $(2 + x - x^2)^5$.

Key to Exercise 32

(1) -4. (2) $\frac{6}{3-n}$. (3) $\frac{36}{7}, \frac{36}{5}$. (4) $\frac{32}{13}, \frac{32}{10}, \frac{32}{7}$. (8) 6, 18, 54.

Key to Exercise 33

(1) 151200; 420; 1,814,400.

(2) $4 + {}_5P_5 - {}_4P_2 = 112$. (3) m^n.

(4) $\frac{1}{2}$ of $\{{}_nP_n - 4\,{}_{n-1}P_{n-1} + 2\,{}_{n-2}P_{n-2}\}$
$= \frac{(n-2)(n-3)}{2} \times (n-2)!$

(5) 3^{12}. (6) ${}_8P_3 \times {}_6P_4 \times {}_8P_4 \times {}_6P_3$.

(7) ${}_nC_2$; ${}_nC_3$; ${}_nC_4$.

M. A. L.

MECHANICS.—II

9. When velocity is variable, the rate at which it changes can be measured.

Acceleration, is defined as *the rate of change of velocity.* This change may be in magnitude or in direction or in both.

When the acceleration in any direction is uniform, it is measured by the change in velocity divided by the time taken to effect the change. Thus if a velocity v_0 increases to a velocity v_1 in time t, then the acceleration is $\frac{v_1 - v_0}{t}$, or $a = \frac{v_1 - v_0}{t}$.

Now if a body starts from rest, its initial velocity is zero, i.e. $v_0 = 0$, and in that case we have $a = \frac{v}{t}$, where v = velocity acquired in an interval of time t by a body starting from rest.

Thus we see, acceleration bears the same relation to velocity that velocity does to distance. And as a velocity may be described as so many feet per second $\left(\frac{\text{ft.}}{\text{sec.}}\right)$, so acceleration may be described as so many feet-per-second per second $\left(\frac{\frac{\text{ft.}}{\text{sec.}}}{\text{sec.}}\right)$ and this is often written $\frac{\text{ft.}}{\text{sec.}^2}$.

Hence the unit of acceleration is $\frac{1 \text{ ft.}}{\text{sec.}^2}$ or $\frac{1 \text{ cm.}}{\text{sec.}^2}$.

10. In accordance with a much used mathematical convention, if we denote motion in one direction by the positive sign +, we denote motion in the opposite direction by the negative sign —.

Thus if motion, velocity or acceleration from west to east be taken as *positive*, then motion, velocity and acceleration from east to west will be *negative.*

When the acceleration has the same direction as the velocity (i.e. tends to *increase* the velocity), it is called *positive*; when the acceleration has the opposite direction to that of the velocity (i.e. tends to *decrease* the velocity), it is called *negative*, or else it is called a *retardation.*

11. If the acceleration is variable it may be measured in a similar way to variable velocity.

Thus the average acceleration is given by dividing the change in velocity by the time taken to effect the change, i.e. $a = \frac{v_1 - v_0}{t}$. The actual acceleration at any given instant is given by $\frac{v_1 - v_0}{t}$, where t is an infinitesimally small interval of time.

We shall here deal only with uniform acceleration.

Examples :—

(1) If a body move with a velocity of 8 $\frac{\text{ft.}}{\text{sec.}}$, and 3 seconds later its velocity is found to be 14 $\frac{\text{ft.}}{\text{sec.}}$, then the acceleration $a = \frac{14 - 8}{3} \frac{\text{ft.}}{\text{sec.}^2} = 2 \frac{\text{ft.}}{\text{sec.}^2}$.

(2) If a body move with a velocity of 12 $\frac{\text{ft.}}{\text{sec.}}$, and 1 second later its velocity is found to be 9 $\frac{\text{ft.}}{\text{sec.}}$, then the acceleration $a = \frac{9 - 12}{1} \frac{\text{ft.}}{\text{sec.}^2} = -3 \frac{\text{ft.}}{\text{sec.}^2}$.

i.e. the acceleration is opposite in direction to the velocity, and is a retardation.

12. *To find the velocity acquired in a given interval of time by a body travelling with a uniform acceleration a.*

Velocity acquired in 1 unit of time $= a$.
Velocity acquired in 2 units of time $= 2a$
. . . . . .
Velocity acquired in t units of time $= t\,a$.
Hence if v denote the velocity required, $v = a\,t$.

Now suppose the body starts with an initial velocity v_0.

Then as before the velocity acquired in t units of time $= a\,t$.
$\therefore$ the final velocity $= v_0 + a\,t$.
i.e. $v = v_0 + a\,t$.

13. We have obtained two statements which are practically definitions, viz. :—

$$\text{Average velocity} = \frac{\text{distance travelled}}{\text{time taken for journey}},$$

$$\text{or } V = \frac{s}{t} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \text{(i)}.$$

$$\text{Acceleration} = \frac{\text{change in velocity}}{\text{time taken to effect change}},$$

$$\text{or } a = \frac{v}{t} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \text{(ii)}.$$

Now if the velocities at the beginning and end of an interval of time t be v_0 and v_1,

then the average velocity $V = \frac{v_0 + v_1}{2}$

and the change in velocity $v = v_1 - v_0$.

Thus equation (i) may be written

$$\frac{v_0 + v_1}{2} = \frac{s}{t}.$$

$$\therefore s = \frac{v_0 + v_1}{2} t \quad \ldots\ldots\ldots\ldots\ldots\ldots \text{(iii)}.$$

And equation (ii) may be written

$$a = \frac{v_1 - v_0}{t} \quad \ldots\ldots\ldots\ldots\ldots\ldots \text{(iv)}.$$

$$\therefore v_1 - v_0 = a\,t \quad \ldots\ldots\ldots\ldots\ldots\ldots \text{(v)}.$$

From the equations (iii), (iv) and (v) we may get other relations between these various quantities. If we multiply the left-hand members of (iii) and (iv) and equate them to the product of the right-hand members, we get

$$a\,s = \frac{(v_1 - v_0)(v_1 + v_0)}{2}$$

$$\therefore 2\,a\,s = v_1^2 - v_0^2 \quad \ldots\ldots\ldots\ldots\ldots\ldots \text{(vi)}.$$

This is an equation connecting space, velocity and acceleration, without reference to time.

Now from (iv) $v_1 = v_0 + a\,t$.

Substitute this value of v_1 in (iii)

then $s = \frac{2\,v_0 + a\,t}{2} t = v_0 t + \frac{1}{2} a t^2 \quad \ldots\ldots\ldots \text{(v)}.$

This is an equation connecting space, initial velocity, acceleration and time without reference to the final velocity.

14. Let us now consider what would happen if the body starts *from rest*, i.e. $v_0 = 0$. We then get the following equations, where v = final velocity.

$$\left.\begin{aligned} v &= at \\ s &= \tfrac{1}{2} vt \\ s &= \tfrac{1}{2} at^2 \\ v^2 &= 2as \end{aligned}\right\} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \text{(vi).}$$

These results are very important, and may be illustrated graphically as shown in Fig. 1.

Suppose each division on the horizontal line O X starting from 0 represents 1 second of time. And suppose the vertical line O A represents a velocity of 12 $\frac{\text{ft.}}{\text{sec.}}$.

Then the space traversed in 1 second is represented by the rectangle O A B 1 = 12 × 1 = 12 ft.

Space traversed in 2 seconds is represented by the rectangle O A C 2 = 2 × 12 = 24 ft.

. . . . . .

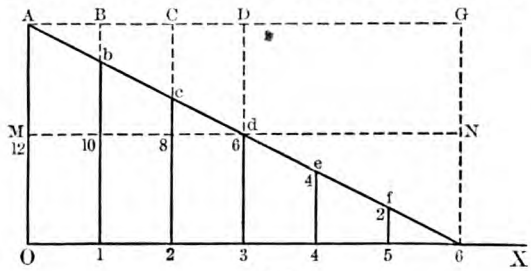


Fig. 1.

Space traversed in 6 seconds is represented by the rectangle O A G 6 = 6 × 12 = 144 ft.

Now suppose this body lose 2 $\frac{\text{ft.}}{\text{sec.}}$ of velocity per second, i.e. it has a uniform negative acceleration (or retardation) of 2 $\frac{\text{ft.}}{\text{sec.}^2}$.

Then its velocity at the end of the first second will be represented by the vertical line 1 *b*, i.e. a velocity of 10 $\frac{\text{ft.}}{\text{sec.}}$.

At the end of the 2nd second its velocity will be 8 $\frac{\text{ft.}}{\text{sec.}}$, and is represented by the line 2 *c*.

It is clear from the diagram that at the end of 6 seconds the velocity will be zero, i.e. the body will come to rest in 6 seconds.

The average velocity will be 6, and is represented by the line *d* 3.

The distance traversed would be this average velocity multiplied by the time, and may be geometrically represented by the rectangle O M N 6 = 6 × 6 = 36 ft. That is to say, the distance can be represented by the triangle O A 6, whose area = $\frac{1}{2}$ O A × O 6 = $\frac{1}{2}$ × 12 × 6 = 36 ft.

The student should note that in the above diagram areas represent distances.

The motion of a body starting from rest with a positive acceleration of a $\frac{\text{ft.}}{\text{sec.}^2}$ is represented in Fig. 2.

The body starts from O with a velocity $v_0 = 0$. At the end of 1 second the velocity v_1 is represented by the vertical line a; at the end of t seconds the velocity v is represented by the vertical line X A = at, and the average velocity acquired in time $\frac{1}{2} t$ is represented by the vertical line $\frac{1}{2} v$.

The area of the triangle represents the distance travelled = $\frac{1}{2} v \times t$ or (expressing the same thing differently) $\frac{1}{2} at \times t = \frac{1}{2} at^2$.

If the body had started with an initial velocity v_0, we may represent its motion as in Fig. 3.

Its velocity v_t after t seconds is represented by the vertical line X A = $v_0 + at$.

The distance travelled is represented by the area of the rectangle O B C X + the area of the triangle A B C = $v_0 t + \frac{1}{2} at^2$.

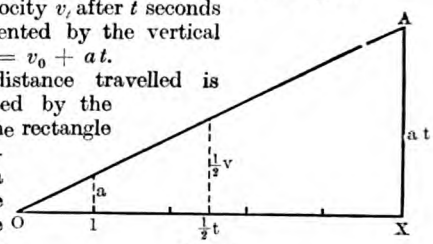


Fig. 2.

The dotted line in the midde of the diagram = $v_0 + \frac{1}{2} at$ or (expressing the same thing differently) $v_t - \frac{1}{2} at$.

∴ this dotted line = $\frac{1}{2} (v_0 + v_t)$, i.e. it represents the average velocity.

Examples :—

(1) A body starts from rest and after 5 seconds has acquired a velocity of 30 $\frac{\text{ft.}}{\text{sec.}}$. What is its acceleration and what distance will it have travelled in 5 seconds ? How long will it take to travel 192 ft. ?

$a = \frac{v}{t} = \frac{30}{5} = 6 \frac{\text{ft.}}{\text{sec.}^2}$ = its acceleration.

$s = \frac{1}{2} at^2 = \frac{1}{2} \times 6 \times 25 = 75$ ft. = distance travelled.

Or, $s = \frac{1}{2} vt = \frac{1}{2} \times 30 \times 5 = 75$ ft. = distance travelled.

$s = \frac{1}{2} at^2 \therefore t^2 = \frac{2 \times s}{a} = \frac{2 \times 192}{6} = 64.$

$\therefore t = 8$ seconds.

(2) A body moving with a velocity of 100 $\frac{\text{ft.}}{\text{sec.}}$ receives an acceleration of $-10 \frac{\text{ft.}}{\text{sec.}^2}$. What is its velocity after 3 seconds ? How long will it take to come to rest ? What distance will it have travelled when it comes to rest ?

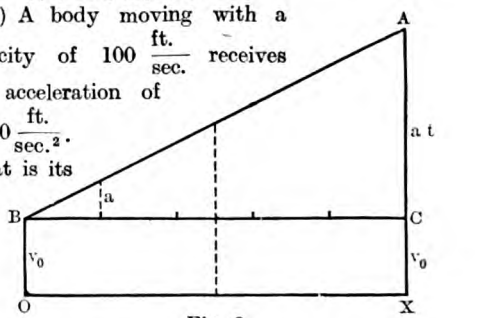
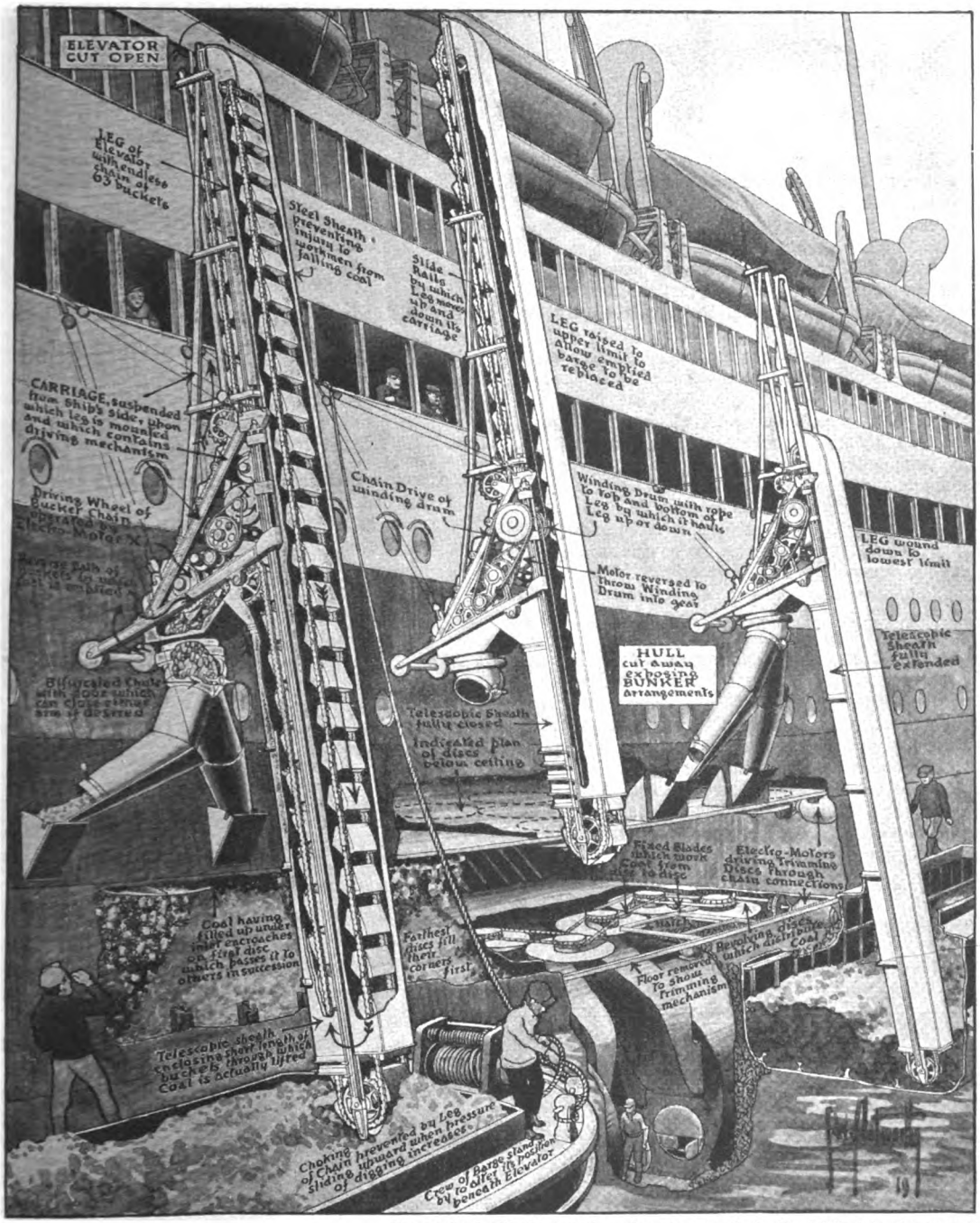


Fig. 3.

Velocity v_3 after 3 sec. = $v_0 + at$

= 100 − 10 × 3 (since acceleration is negative)

= 70 $\frac{\text{ft.}}{\text{sec.}}$.



Drawn by S. W. Clatworthy, after photographs in the "Scientific American."

COALING BY MACHINERY.

New mechanism for doing in one day what hand labour would take four days to accomplish. The Michener elevator, shown above, weighs only $5\frac{3}{4}$ tons but can normally load 150 tons per hour; whilst the trimming mechanism, designed as a permanent part of the ship, enables coal to be distributed in the bunkers at the rate of 150 tons an hour.

If it comes to rest its velocity v_1 will = 0.

$v_1 = v_0 + at$

$\therefore 0 = 100 - 10t$

$\therefore 10t = 100 \quad \therefore t = 10$ sec.

Distance travelled in that time = s.

$s = v_0 t + \frac{1}{2} a t^2$

$= 100 \times 10 - \frac{1}{2} \times 10 \times 100$

$= 500$ ft.

15. It is a fact with which everyone is familiar that heavy bodies, when unsupported, fall to the ground, and moreover that the speed with which they fall increases continuously. This phenomenon is due to the attraction exercised by the mass of the earth. This force acts on every body near the earth and causes it to fall in a vertical line towards the earth's centre. It is called the force of **Gravity,** and the acceleration due to it is denoted by g.

This acceleration is found by experiment to be the same for all bodies, irrespective of their size and weight.

If we drop a coin and a sheet of paper from a height at the same moment, we shall find that the coin reaches the ground first, and if we also release a balloon at the same moment it will rise instead of falling. This might lead us to suppose that gravity acts differently on different bodies, but the different behaviour of these bodies is really due to the fact that the atmosphere itself has weight. The balloon will rise because it is filled with a gas that is lighter than air. The coin and the paper in falling set in motion the particles of the atmosphere, and the paper, having a larger surface than the coin, has to set in motion more particles of air and thus encounters more resistance. More time is required to overcome this resistance than the smaller resistance offered to the coin, and therefore the piece of paper takes longer to reach the ground.

If, however, these bodies are released at the same moment in a tall jar from which the air has been removed by means of an air pump, they will be found to reach the ground simultaneously.

16. If a stone is allowed to drop from a height of 16 ft. it will reach the ground in 1 second; if it drops from a height of 64 ft. it will reach the ground in 2 seconds; and from a height of 144 ft. it will reach the ground in 3 seconds.

If we calculate the value of g, the acceleration due to gravity, in these cases we shall find it is always the same.

We have $s = \frac{1}{2} g t^2$, which gives us

(1) $16 = \frac{1}{2} g \times 1^2 \therefore g = 32 \frac{\text{ft.}}{\text{sec.}^2}$.

(2) $64 = \frac{1}{2} g \times 2^2 \therefore g = 32 \frac{\text{ft.}}{\text{sec.}^2}$.

(3) $144 = \frac{1}{2} g \times 3^2 \therefore g = 32 \frac{\text{ft.}}{\text{sec.}^2}$.

Thus we see that the acceleration due to gravity is uniform and equals $32 \frac{\text{ft.}}{\text{sec.}^2}$.*

* NOTE.—The acceleration due to gravity is more nearly equal to $32{\cdot}2 \frac{\text{ft.}}{\text{sec.}^2}$, or in metric terms $981 \frac{\text{cm.}}{\text{sec.}^2}$, but as a rule $32 \frac{\text{ft.}}{\text{sec.}^2}$ is sufficiently accurate for our purpose.

Example:—

A ball is dropped from the top of a tower 100 ft. high, and at the same moment another ball is thrown vertically upwards from the bottom of the tower with a velocity sufficient to make it reach the top. Where and when will the balls pass each other?

Let us consider the ball thrown upwards.

Its initial velocity is destroyed by the downward acceleration due to gravity when it has travelled 100 ft.

If this initial velocity be v_0,

since $v_0^2 = 2as = 2 \times 32 \times 100$

$\therefore v_0 = 80 \frac{\text{ft.}}{\text{sec.}}$.

The ball dropped starts from rest with an acceleration of $32 \frac{\text{ft.}}{\text{sec.}^2}$. The ball thrown up starts with an initial velocity $80 \frac{\text{ft.}}{\text{sec.}}$ and a retardation of $32 \frac{\text{ft.}}{\text{sec.}^2}$. When they pass each other the sum of the distances traversed by each must = 100 ft.

If the distance traversed by the ball that is dropped = s_1 and the distance traversed by the ball that is thrown = s_2

$s_1 = \frac{1}{2} g t^2$

$s_2 = v_0 t - \frac{1}{2} g t^2$

$\therefore s_1 + s_2 = v_0 t$

$\therefore 100 = 80t \therefore t = 1\frac{1}{4}$ second.

In time $t = 1\frac{1}{4}$ second, $s_1 = \frac{1}{2} g t^2 = \frac{1}{2} \times 32 \times \frac{25}{16}$

$= 25$ feet.

$\therefore$ the balls pass each other 25 ft. below the top of the tower $1\frac{1}{4}$ sec. after starting.

Exercise 2

(1) What will be the velocity after 2 minutes of bodies starting from rest with accelerations of 2, 7, 10, 20 and 30 $\frac{\text{ft.}}{\text{sec.}^2}$? What distance will each travel in that time?

(2) A body starts with a velocity of 10 $\frac{\text{ft.}}{\text{sec.}}$ and after 15 seconds has acquired a velocity of 120 $\frac{\text{ft.}}{\text{sec.}}$. What is its acceleration? What distance has it gone?

(3) A body starts with a velocity of 200 $\frac{\text{ft.}}{\text{sec.}}$ and has a negative acceleration of 10 $\frac{\text{ft.}}{\text{sec.}^2}$. How soon will it come to rest? What distance will it have gone when it comes to rest? In what time will it have travelled 720 ft.?

(4) If you throw a ball into the air and catch it after 8 seconds, how high will it have gone and what will be its velocity when it reaches your hand again?

(5) A body moves from rest with an acceleration of 20 $\frac{\text{ft.}}{\text{sec.}^2}$. How far will it travel during the 5th second after starting?

Key to Exercise 1

(1) 158 $\frac{\text{ft.}}{\text{sec.}}$. (2) $2\frac{1}{2}$ minutes. (3) 66 $\frac{\text{miles}}{\text{hour}}$ is greater by $16\frac{2}{3} \frac{\text{ft.}}{\text{sec.}}$.

M. A. L.

Continued from Vol. III., page 436.

ART AND MUSIC:

Contributors **:—THE THEORY OF ART (Hon. John Collier; J. G. B. Lynch). DRAWING AND PAINTING (J. G. B. Lynch). THE THEORY OF MUSIC (R. R. Terry, Mus.Doc., F.R.C.O.; Hubert Grant).**

DRAWING.—XV

FROM discussing generalities let us turn to the practical side of figure drawing. There is no need to recapitulate what has been said in previous lessons applying to this branch of study, as I shall take it for granted that you have thoroughly familiarised yourself with each step as I have given it, and so are in a position to embark upon this more difficult form of work. It is as well, however, to remind you of the emphasis laid upon the importance of observing closely the rules of proportion. In order to acquire any real success as a figure painter it is necessary to obtain a certain amount of anatomical knowledge—the more, of course, the better. The great masters of figure painting and drawing, remember, acquired a knowledge of anatomy second only to that possessed by eminent surgeons, so that the formation of the figure must be carefully studied.

Change of Expression

The chief cause of the difficulty in becoming efficient arises from the fact that each movement of the body and every expression of the face brings a different set of muscles into play. The slightest alteration in pose, or change of expression, therefore, alters considerably the curve of every line and also its proportions. For example, if the expression of the face changes from repose into the merest indication of a smile, the least movement of the mouth, which betrays the new emotion, will alter also the whole composition of the face. The lines of the eyelids will also change.

In short, each new emotion brings a complete change of expression. The lines which form the face, you will notice, are almost entirely curved, there is hardly a straight one to be found in the drawing even of a profile, much less in that of the full or three-quarter pose. Consequently when you attempt to draw the face you have to deal with angles and distances that are formed by curved lines. The treatment of these you will find at first much more difficult than any composition formed by straight lines, and you will require a certain amount of practice before you are able to estimate truly the angle that one curve makes when meeting another.

The best and quickest way to gain proficiency in this new field of study is to begin by treating the curved lines as though they were perfectly straight. In doing so it is obvious that for the time being you must disregard their flexure, but their point of meeting and their relative angles and distances must be very carefully adhered to. Let us take, for example, the profile of a face, and treat it in the manner just suggested. Your object will be to build up the outline in its true proportion as though it were a geometrical figure, and could be drawn almost entirely by the aid of a ruler and set square. To understand exactly what is meant, study the profile of a face on this plan (*see* Fig. 83).

Studies in Profile

The main features, you will observe, are composed entirely of straight lines. If you begin by practising to draw a profile in this way, you will find that you will very soon become familiar, not only with the angle that the line of each feature makes with the adjacent one, but you will also very soon gain an accurate knowledge of their relative lengths.

I should strongly advise you to make a copy of a profile in this way several times in succession, and as you limn in the lines, you should be very careful to note minutely the angles that they form, and the proportions they bear one to another. If your lines are in proportion, and your angles are accurately gauged, you will see at once that even in this preliminary exercise the profile has a strong likeness to the finished copy, though the contours are entirely absent.

I cannot insist too much upon the necessity of taking the trouble to master this first step thoroughly before you hasten to attempt a finished drawing; and if you carry out this suggestion you will be well repaid for your patience and perseverance. Many beginners are too eager to try the second step before they have thoroughly mastered and gained facility in executing the preliminary drawing, and the consequence is that they never obtain that fundamental knowledge which is so vital to future success.

So much for the general method to be employed.

Now it is necessary to explain the details. As already said, your first attempt must be made upon a profile. Look at Fig. 83. If you were to copy this figure without help you would, in all probability, begin your drawing at the top of the forehead, and so work downward towards the chin. I do not, however, advise this method.

Undoubtedly the best place to start is at the bridge of the nose; that is to say, your initial line will be from point *a*. The reason for starting here is that the most vital angle in the com-

Fig. 80.

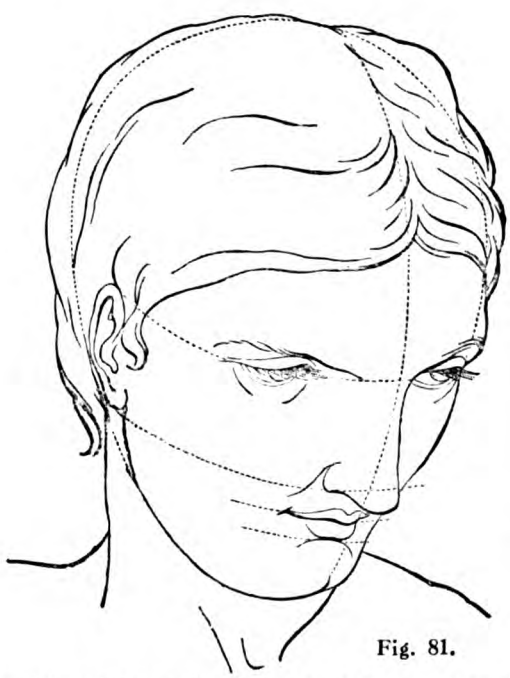


Fig. 81.

position of the profile of the face is the one formed by the conjunction of the lines of the forehead and the nose. In many cases you will find it advisable to carry out this method also when you are dealing with other views of the face—that is, when drawing full and three-quarter poses. Having determined, therefore, the point *a*, draw by means of a perfectly straight line the whole bridge of the nose.

This brings you to point *b*. You must note very carefully, of course, the distance and inclination. Having proceeded thus far, from this point drop a perpendicular dotted line to the point *f*, being careful to make it of such a length as to be exactly level with the point where you propose to draw the tip of the nose—that is, point *e*. Now connect these two points, *f* and *e*, by means of a dotted line which will be in a horizontal position. Your next step is to join points *b* and *c* by means of a perfectly straight line.

The triangle thus obtained gives you a true foundation upon which to complete the formation of the nose. Mark the point where you consider the curve of the nose becomes most prominent, which

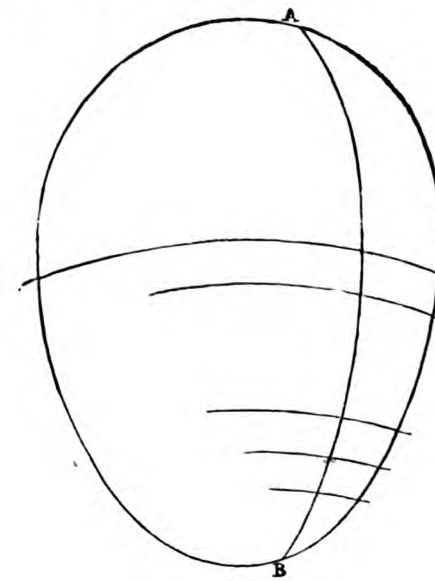


Fig. 82.

in this case is about midway between points *b* and *e*. Now draw straight lines from *b* to *d* and from *b* to *e*; by this means you get the flexure of the curve. Now turn your attention to point *a* again and determine point *c*, noting carefully the distance and inclination, and having done so connect these two points; in like manner indicate *g* and *h*; and, adhering strictly to the same method, complete step by step the entire profile as it is drawn in the figure.

You must pencil in the scaffolding, as we may call it, by means of very light lines, and then, upon the structure so obtained you can complete your drawing—that is, when once you have executed the preliminary work satisfactorily, you can make the finished drawing, showing the delicate curve seen in Fig. 84, never losing sight of the fact that each angle must converge exactly to the points already determined in the preliminary figure.

I cannot emphasise too strongly upon you that

the essence of success lies in the degree of accuracy which you display in drawing the preliminary geometrical figure, as I have termed it. In order to obtain a satisfactory result, be sure you make several drawings of Fig. 83, before you attempt the completed drawing as in Fig. 84.

In drawing Fig. 85, which shows the profile looking in the opposite direction, you must employ exactly the same method that you have used in drawing Fig. 84. First build your geometrical scaffold, and when that has been satisfactorily arranged, make your finished drawing upon its foundation.

Let us turn our attention to the three-quarter and full face. I am assuming, of course, that you have already become proficient in drawing the profile. Look at Fig. 82, which is the outline for a three-quarter face. The first thing that strikes you is that the formation of the head is obtained by drawing an egg-shaped figure, the narrower end forming the chin, the broader end forming the top of the head.

As this figure gives the outline for drawing a three-quarter face, your first efforts must be directed towards gaining the ease in drawing accurately and with the utmost freedom. Teach yourself by practice to draw this figure in various sizes and at various angles. Look at Figs. 80 and 81. You must bear in mind that the oval or egg-shaped formation of the head is, in reality, a solid, but the lines which you draw to represent the head and to show the exact position of the features and proportions are supposed to be drawn upon the surface.

You must keep these facts carefully before you when you arrange the position of the face you are about to draw. In both the upward and downward inclination of the head this same formation occurs, the contour varying only very slightly according to the angle at which the head is poised. When you have successfully drawn the outline of the head, mark by means of a very light line the curve from A to B as shown in Fig. 82.

This line passes through the centre of the forehead, mouth and chin. Next indicate the bridge of the nose and the centre of the eyes by means of a light line running at right angles to A and B. Draw in a similar manner the line showing the positions of the eyebrows, the base of the nose, the centre of the mouth and the indentation of the chin. These lines serve as the framework upon which to draw the face, whether it be turned upwards or downwards.

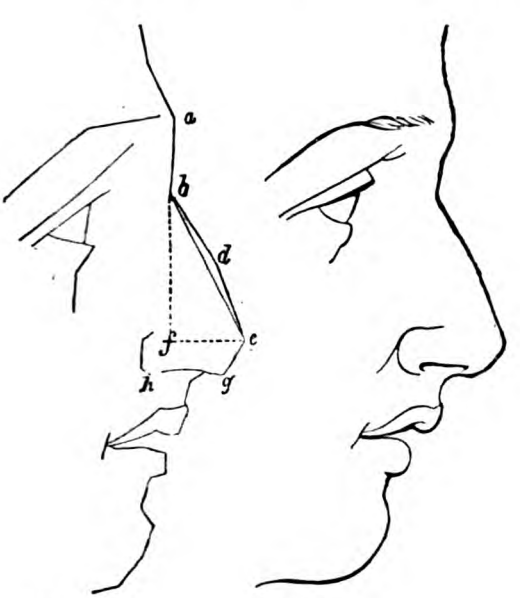


Fig. 83.

Fig. 84.

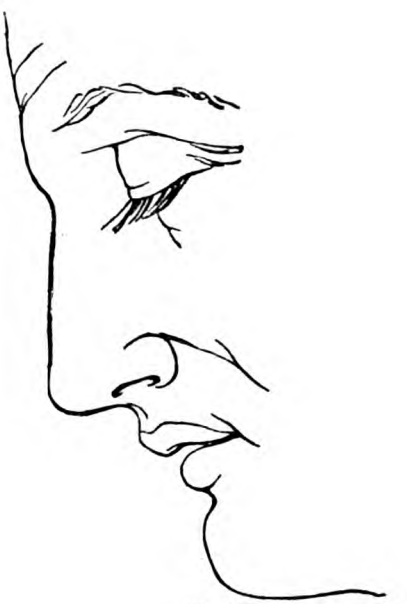


Fig. 85.

Studies in profile—showing how the outline may be built up as though it were a geometrical figure.

To sum up, you perceive that when the head is parallel, or full face, your guiding horizontal lines are straight, whereas when the head is turned upwards or downwards those lines become curved.

As I have said, the least movement of the face or figure changes the outline, and it is by close study only that your eye can be trained to appreciate these modifications at their true value. To the unpractised observer many of these slight changes in form will pass unnoticed, but the educated eye instantly detects the alteration, however trivial.

Consequently the more you exercise this faculty, the greater artist you will become, and bear in mind that this power can only be acquired by constant practice.

You will find that its use not only is of value in drawing with the pencil, but is equally essential when dealing with half-tints, so that if you have acquired the full measure of your ability in this

respect, while studying line work, you will benefit by your industry when you come to work with the brush in mono-tints and varied colours. The laws and rules you have mastered you will find will be quite as useful to you in painting as they are in line work.

In this lesson we have been simply discussing form, but the keener your sense of perception in this respect the greater will be your appreciation of delicacy of tone and gradation tint, which is so essential to successful colour work.

J. G. B. L.

DECORATIVE ART.—II

I PROPOSE now to describe what I regard as two good rooms, the one simple, the other elaborate—a cottage sitting-room and the dining-room of a big house.

The cottage sitting-room which I choose as an example of the good simple room is lit by a long low window. This is extremely pleasing to the eye, but the result is that the room is prone to be a little dark. It is a long room and low, and the first point is to make it as light as possible. So the walls are covered with white distemper. This is not particularly cheap, but it washes and lasts well. It is a cottage in name but it is not a workman's cottage : therefore any attempt to imitate the country workman's characteristic fireplace is wrong. It would only be an imitation.

A Cottage Sitting-room

In this case there is a chimney piece of red brick coming out about six inches into the room, having therefore six inches on the top to serve as shelf. The fireplace opening is semi-circular, with a good modern grate. The hearth is also of brick, slightly raised. The floor is of dark stained boards.

Then there is a good rug by the fireplace with brick-red as its predominant colour. There is another and larger one on the other side of the room. Beneath these the floor is covered, save for a bare couple of feet immediately round the walls, with dark red felt.

The walls have a plain white picture-rail which runs at two feet from the ceiling. There is no cornice. The ceiling runs straight back to the top of the wall without a break. There are two doors, one leading to the little closed-in stairway and the other to the porch and entrance. These are of rough oak boards, crudely cut, well put together. They are left in their natural colour and have latches of wrought iron. In the middle of the room is a long heavy oak table, a copy of a fifteenth century side-table.

On either side of the fire are big cosy arm-chairs which have comfort before appearance as their main idea. These are upholstered in a plain unornamented cretonne of a darkish blue, rich, and if liable to fade (as most blues are), likely to fade evenly, still in a good tone. There is a plain iron cauldron painted black for coals, an iron poker and simple tongs and shovel—of the strictly practical sort. There is a long bench by the table, again a copy in rough oak, and two or three more chairs, rush bottomed and ladder backed. Beneath the window is an oak chest.

Simple Effects

On the opposite side of the room is a bureau with a book-case over it. A small case for books constantly in use is nearer the fireplace, over which is an oval looking-glass, opposite a little black piano. There are in all six engravings in dull narrow black frames, and over the piano is a water-colour impression of a woman in a vivid scarlet cloak, giving a touch of colour much needed over the black case. The curtains are of dark blue. There are no blinds. There are two brass candlesticks on the shelf over the fire and a very simple brass lamp on the table.

That is all.

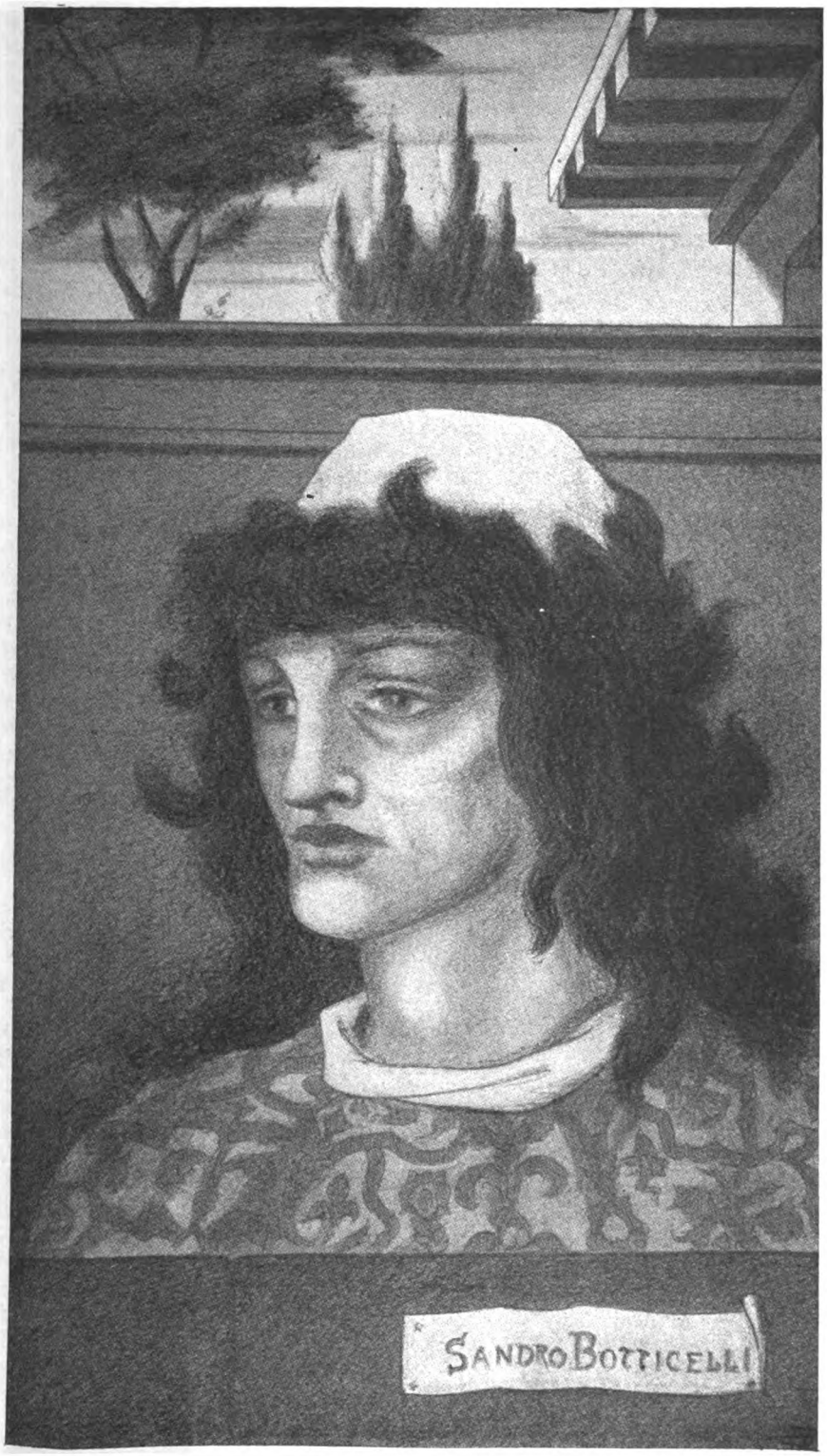
And yet it will surely happen that when the room has been lived in for a while there are many things which creep in to make it both home-like and decorative—a work basket, a few pipes on the mantel, with a box of tobacco, a blotting-pad and ink pot, pens thrust into a mug, and flowers.

These objects will lend an air of intimacy to the room, which otherwise it might have lacked.

The impression of this simple though studied and deliberate arrangement should combine an effect of beauty with a sense of restfulness.

It would be as fatal to overcrowd the walls with pictures as it would be to hang up half-a-dozen ill-assorted ones ; it would be equally disastrous to cumber the shelves and mantelpiece with odd knick-knacks and pieces of china. The harmony of the colour scheme would be upset ; the serenity of the room would be disturbed.

The next article will deal with the elaborate dining-room. J. G. B. L.



SANDRO BOTTICELLI.

A striking example of the art of Aubrey Beardsley.

Continued from Vol. III. page 504.

BUSINESS AND COMMERCE:

Contributors:—BOOK-KEEPING (Frederick Heelis, F.C.I.S.). SHORTHAND (by arrangement with Pitman's Schools). COMMERCIAL TRAINING (Arthur Brooke). CHOOSING A CAREER (A. C. Marshall).

COMMERCIAL TRAINING.—XXIII

BETWEEN the producer or exporter of goods and the consumer there come two separate classes of middlemen—the wholesaler and the retailer. The former buys the goods in large quantities and is in close touch with the actual supply; the latter is concerned with smaller quantities, but has his dealings direct with the consumer and can therefore gauge the demand. In the main markets of the world, then, it may almost be said that the wholesaler represents the producer and the retailer the consumer.

In the last lesson we went fully into the question of the work and routine of the wholesale merchant. In this lesson we propose to open the subject of retail trade; and it should be understood at the very commencement that relatively the retailer is in no sense a lesser business man than the wholesaler. In fact, there are innumerable instances where purely retail businesses are larger and more influential than many wholesale houses in precisely the same section of general trade.

Retail Trade

And, even so far as initial capital is concerned, it is by no means the case that the retailer can be successful with a smaller sum than the wholesaler. The wholesaler makes less profit upon an individual article; but has a far quicker turnover of business. Moreover, he does not have to face the depreciation of stock quite to the same extent as the retailer.

Our point is that the student must not begin to make comparisons between wholesale merchants and those who deal in a retail way. They are not to be compared, for they trade by totally different methods. Each of equal importance in the scheme of trade, the wholesaler is not necessarily a better business man than the retailer; nor does a successful retailer grow or develop into a wholesaler.

There are two ways of becoming a retail merchant or shopkeeper. One is to open a totally new business and the other to buy a business already in existence. In the former case there is nothing to pay beyond the ordinary charges for rent and accommodation; in the latter case one has to compensate the owner of the business for all his time and effort in building it up. In other words, one has to purchase the "goodwill" of the business.

Opening a Shop

To deal first with the opening of a totally new retail business, it will be obvious that there are many points to be considered. For many weeks the locality must be studied at first hand and note be taken of the number of possible customers, opposition in the same line of business, and whether many new residential houses are being built or are likely to be built. The metamorphosis of a suburb, for example, is so slow as to be almost imperceptible, but a clever retailer who has studied these matters would be able to forecast the movement and to prophesy with considerable accuracy whether a district were going to improve or otherwise.

The movement, generally speaking, is outwards. Thus, a suburb that to-day shelters the best classes of a city may, in ten years' time (unless building facilities are curtailed by high prices) probably have fallen a little socially, whilst a new suburb a distance further on will have developed for the richer classes.

Then again, it must be remembered that the greatest profits do not always accrue from the richest patrons. In many cases a retailer in a poor-class district can earn greater profits than one in an aristocratic quarter because frequently there is more to be made by selling in minute quantities, and with the poor there is little credit and consequently few bad debts.

A clever tradesman, therefore, might well foresee the subtle changes in a suburb or

district from affluence to comparative poverty and be able to open a lower class business at the exact moment when the chance for building up the right connection arrived.

In any case the opening of a completely new business requires a great deal of time and care ; and it is not a matter to be rushed into blindly. The initial step should be to find suitable premises and even then it would be quite in order to seek an option on them for a month whilst further inquiries were pursued.

The next step should be to secure the premises upon favourable terms ; and no tradesman should take a place without the assistance of a solicitor, for there are many legal traps against which provision must be made.

A common plan in the case of a newly-established business is for the landlord to let at a low rental for the first two or three years upon the basis of an agreement. A clause in this agreement would give the tenant the option of taking out a lease upon the premises at the termination of the agreement at a fixed rental. In certain cases a clause should appear giving the tenant the right of purchase before the passing of a given date at a fixed price.

Protecting the Tenant

The whole point is that the tenant must seek his own protection ; or, having worked up his business until it was a sound commercial success, it would be only natural that the landlord should endeavour to raise the rent, for his premises would have attained to a much higher value. The importance of this point and the general intricacy of the law make the employment of a solicitor imperative in attending to this phase of the task in hand.

Having considered this point, and also borne in mind that rates and taxes are fixed largely according to the scale of rent paid, the next matter for attention is the capital required. Being a new shop, there will probably be no trade fixtures beyond a counter ; and in some cases even that is not provided by the landlord. There will be shelves, showcases, window fittings. blinds, lights, cabinets and similar fitments, and the expense entailed in this direction is likely to be very heavy.

Then comes the question of stock—new in its entirety—stock for the shop ; and also an ample surplus to be stored in the cellars or warehouse rooms available. And, as the trade of the district is to a great extent unknown, the stock must be broadened to meet all eventualities, so that the first supplies purchased must inevitably to some extent be in the nature of a gamble.

Further, if this stock can be paid for in cash it will be ultimately to the material advantage of the retailer ; for to start a shop on credit entails a considerable loss both of money and also of prestige.

But, over and above all these points, the new shopkeeper must have something in hand upon which to live for many weeks. No new shop can be expected to pay its way from the very commencement, and there are all sorts of contingent expenses that have to be met. Certainly, too much attention cannot be paid to the subject of capital for a new retail business ; and the success of the business might well be placed in jeopardy because at a critical moment the supply of ready money ran short.

Buying a Business

We are assuming of course that the person beginning this retail business is thoroughly conversant with the particular trade. This being the case, he will be well in touch with the commercial travellers from the wholesale houses and will know how to buy to the best advantage.

Certainly no one should enter upon a retail business without long and useful experience ; and it should be highly advisable for a person without knowledge who wishes to open a shop to take a position for a time in a similar type of shop.

Bearing all these points in mind, we must next compare the starting of a new retail business with the buying of an existing connection, a matter that will later be gone into in full detail.

We may mention now, however, that in the first instance nothing has to be paid for a goodwill but in the latter case there is an actual connection to be purchased ; and. a retailer going into a business bought as a going concern may rely upon receiving far more at the commencement than he would do in the case of new premises. In the one instance, the retailer is starting with absolutely nothing ; no connection, no goodwill, only uncertainty. With an existing business, even if it has been "let down," a good deal of this risk is eliminated.

At the same time, the buying of a business shows a great many elements of risk and danger. The seller places a far larger value upon the business than any buyer would do ; and the buyer in conducting his negotiations is naturally working very much in the dark.

A. B.

CHOOSING A CAREER.—XXV

Journalism as a profession is so subdivided that classification presents considerable difficulty, one department overlapping another at every turn. We may, however, well commence by describing the work and prospects of the *Newspaper* journalist, who is on a totally different footing from the magazine and periodical journalist.

The *newspapers* of this country, which are becoming less and less devoted exclusively to the mere purveyance of news and more and more concerned with the topical matters of everyday life, are staffed by a wonderful array of all the talents.

There is the editor-in-chief; a director of policy, a stern critic, and a man who gives his inspiration to those working under him. There is a night editor; a news editor; a financial editor; a sporting editor; a fiction editor; and probably others. There are the sub-editors, one for each of the main departments of the newspaper activity; men who prune the "copy" of the writers, dress it, and actually prepare it for the press.

There are the reporters, men who go out—perhaps to the uttermost ends of the country—garnering news; and those super-reporters, the special correspondents or special commissioners, men who are constantly travelling for the descriptive writing of vitally important happenings.

There are the resident local correspondents, who supply the minor items of local news at a fee of a penny a line; in some cases with a small retainer. There are the writers of leading articles, and those of special leader-page articles, experts in compiling poster matter, librarians who collect and collate newspaper cuttings and similar items for ready reference; and many others.

Each of these men—most of them specialists in some particular direction—contributes of his labour to the making of each day's paper; and the toil of all, assembled and supervised by the editor-in-chief, goes to make the modern newspaper—even though it is sold for the modest sum of one penny.

And it should here be explained that there are many journalists who could not edit, or criticise, or select; just as there are many editors to whom professional writing is an impossible art. True, there are countless all-round men who are both editors and writers, equally accomplished in either direction; but the point to remember is that there are two separate and distinct callings represented by editorship and by journalism. The editor knows what the public requires; the journalist is able to provide the fare.

Reporters require to be masters of shorthand; and to have a born instinct for the news interest. Descriptive reporters, or special correspondents, rely more upon their own personalities in rendering for the public smart individual reports of events and functions. For instance, in the Gallery of the House of Commons there are "sketch" writers, who render an account of the proceedings in an individual way; just as there are reporters who write purely verbatim details.

Junior reporters may commence upon a salary of £1 a week; but there are many chief reporters earning £500 a year; whilst special correspondents and descriptive men may earn from £300 to £700. Sub-editors on important newspapers are frequently paid from £400 to £800. Editors of leading London dailies earn from £800 to £2,000 a year; in some circumstances working on a commission or royalty basis, and frequently occupying seats on the board of directors of the company. There are no rules as to salary; and it may safely be said that the newspaper man is paid almost entirely upon his merits, rather than upon any set standard or precedent.

Turning now to the ranks of *magazines* and popular periodicals, we find a totally different type of journalist. Here, again, we have editors and authors; and there are many most successful editors who have never written for publication. A knowledge of public taste and requirements, both in the way of fiction and article fare, is essential to editorial progress; and this must naturally be very largely a matter of instinct and of self-education.

A periodical sub-editor may earn from £2 to £6 a week; whilst editors receive from £6 a week to £1,000 a year, or even more when they have charge of several journals on a commission basis. So far as magazines are concerned, the pay and prospects are much about the same; for it must be remembered that usually there are only twelve issues in a year, so that the staff is, proportionately, not so large.

Among the weeklies and monthlies, too, there is every chance for the specialist. The ability to write, coupled with a practical knowledge of aeroplanes for example, or of agriculture or arts and crafts generally, may quite conceivably lead to permanent life-long employment; and for almost every trade there is a specialist publication.

A. C. M.

BOOK-KEEPING.—XIX

THE preparation of final accounts is work which very generally devolves upon the professional accountant or auditor, but in recent years there has been a tendency on the part of examiners in Book-keeping and Accountancy to give greater prominence to exercises intended to test the ability of the candidate to prepare final accounts from the figures available in the Trial Balance.

Preparing Final Accounts

The preparation of final accounts from the Trial Balance figures, though differing in detail, is in principle the same, and the student will do well to remember that the figures in the Trial Balance represent in every case the balances of Ledger accounts. We will consider an example taken from an examination paper of the Chartered Institute of Secretaries.

From the following Trial Balance prepare Trading and Profit and Loss Accounts, and Balance Sheet, first writing off £100 for depreciation of Lease, and £200 for depreciation of Plant. The stock on 31st December, 19.., was £800.

TRIAL BALANCE 31ST DEC., 19..

	£ s. d.	£ s. d.
Capital		5,000 – –
Plant and Machinery	2,000 – –	
Drawings	500 – –	
Bills Receivable	900 – –	
Sales		20,000 – –
Cash	800 – –	
Creditors		3,000 – –
Debtors	5,000 – –	
Purchases	10,000 – –	
Salaries	500 – –	
Wages	5,000 – –	
General Expenses	900 – –	
Rent	400 – –	
Stock (1st Jan., 19..)	1,000 – –	
Bad Debts	100 – –	
Discount	200 – –	
Lease	700 – –	
	£28,000 – –	£28,000 – –

In working this exercise, the student is reminded that every item on the Debit side represents either a loss or an asset, whilst the items on the Credit side consist of either gains or liabilities, and Capital.

We will begin by extracting from the Trial Balance the items which directly concern Trading. On the Debit side of the Trading Account, we expect to find :—

(*a*) Stock at the beginning.
(*b*) Purchases (Less Returns Outwards).
(*c*) All expenses which directly affect Trading (such as Wages).

On the Credit side, we find :—

(*a*) Sales (Less Returns Inwards).
(*b*) Stock at the end of the period.

The difference between the two sides will represent the Gross Profit or Loss, and this will be transferred to the Profit and Loss Account. It should be noticed that Wages are assumed to be productive, and thus go to Trading Account unless the contrary is stated.

The Trading Account for the above exercise when completed will appear as follows :—

Dr. TRADING ACCOUNT *Cr.*

			£	s.	d.				£	s.	d.
Jan.	1	To Stock	1,000	–	–	Dec.	31	By Sales	20,000	–	–
Dec.	31	„ Purchases	10,000	–	–	„		„ Stock	800	–	
„	31	„ Wages	5,000	–	–	„					
„	31	„ Gross Profit (To P. and L. A/c)	4,800	–	–						
			£20,800	–	–				£20,800	–	–

We will now proceed to the preparation of the Profit and Loss Account. The first item to be brought into the Account will be the Gross Profit from the Trading Account. This amounts to £4,800, which sum has been inserted on the Debit side of the Trading Account without any corresponding entry having been made in another account to complete the double entry. By entering this item on the Credit side of the Profit and Loss Account, the double entry is completed. Referring again to the Trial Balance, it will be necessary to transfer to the Profit and Loss Account all gains or losses which have not been entered in the Trading Account.

Balance Sheets

At the head of the exercise, instructions are given to write off £100 for depreciation of Lease, and £200 for depreciation of Plant. Clearly these are losses, and they should be carried to the Debit of the Profit and Loss Account, the double entry being completed by the Lease Account being credited with £100, and the Plant Account with £200.

The completed Profit and Loss Account will appear as follows :—

Dr. PROFIT AND LOSS A/C *Cr.*

19		£	s.	d.	19		£	s.	d.
Dec. 31	To Salaries	500	–	–	Dec. 31	By Gross Profit (transferred from Trading A/c	4,800	–	–
	,, General Expenses	900	–	–					
	,, Rent	400	–	–					
	,, Bad debts ..	100	–	–					
	,, Discount ..	200	–	–					
	,, Depreciation on Lease	100	–	–					
	,, Depreciation on Plant	200	–	–					
	,, Net Profit ..	2,400	–	–					
		£4,800	–	–			£4,800	–	–

The net profit has now been ascertained. As all the items of profit or loss have now been extracted from the Trial Balance, it follows that the remaining items consist of assets or liabilities only, and these must now be set out in the form of a Balance Sheet. The Balance Sheet will prove the accuracy of the Profit and Loss Account as, when the net profit is transferred to Capital, the Balance Sheet totals should be equal.

It is the usual practice to show in the Balance Sheet the various items of depreciation, and the adjustments in such cases are shown in the completed Balance Sheet, which now appears as follows :—

BALANCE SHEET AS AT 31ST DEC., 19..

Liabilities.	£	s.	d.	Assets.	£	s.	d.	£	s.	d.
Capital	5,000	–	–	Plant and Machinery	2,000	–	–			
Add Net Profit as per P. and L. A/c	2,400	–	–	Less Dep.	200	–	–	1,800	–	–
	7,400	–	–	Bills Rec. ..	..		..	900	–	–
Less Drawings	500	–	–	Cash ..	..		..	800	–	–
	6,900	–	–	Debtors ..	..		..	5,000	–	–
Creditors	3,000			Lease ..	700	–	–			
				Less Dep. ..	100	–	–	600	–	–
				Stock ..	..		..	800	–	–
	£9,900	–	–					£9,900	–	–

It is usual when working exercises of this kind to show the various adjustments in the form of Journal entries. This practice is defended on the ground that it prevents the possibility of the double entry being left incomplete. Such Journal adjustments are described as **Closing Entries.** The only adjustments in these exercises are those representing depreciation, and they will be recorded as follows :—

	£ s. d.	£ s. d.
Depreciation	300 – –	
To Plant and Machinery		200 – –
To Lease		100 – –

Whilst dealing with the subject of Closing Entries it may be mentioned that in some of the public examinations tests are given in the form of Trading Accounts, and candidates are asked to journalise all adjustments and closing entries. From a practical point of view, such entries are seldom of much use, but it is desirable that they should be referred to for the reason stated above.

Briefly, the Closing Entries generally consist of :—

(1) The transfers from subsidiary accounts to Profit and Loss account.

(2) The gross and net profit or loss transfers.

(3) Withdrawals from Capital.

The following are a few examples :—

		£ s. d.	£ s. d.
Profit and Loss Account	*Dr.*		
To Trade Expenses.			
Profit and Loss Account	*Dr.*		
To Bad Debts.			
Trading Account (Gross Profit)	*Dr.*		
To Profit and Loss Account.			
Profit and Loss Account	*Dr.*		
To Capital Account.			
Capital Account	*Dr.*		
To Drawings Account.			

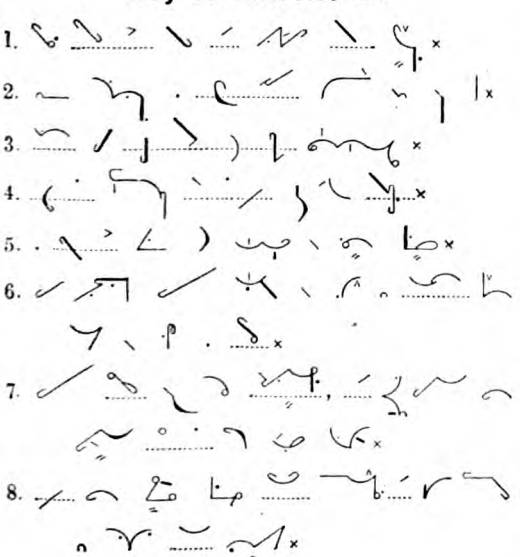
F. H.

SHORTHAND.—XIII

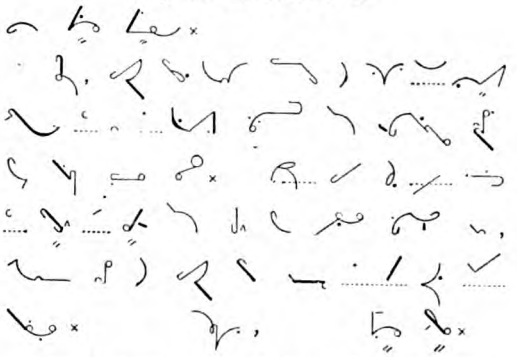
Key to Exercise 45

1. *I-shall-be happy to be with you when next you go to-the house by-the-sea.*
2. *As*-far-*as I-can tell-you, we-shall improve the highway* early *in-the* spring.
3. *I-believe you-will-be able to-suggest* many *improvements and-I-shall-be* pleased *to-have all-the information I-can* get.
4. *The first of next* month *will* suit *me very* nicely.
5. *He and-I wish to be remembered to-the doctor we saw on our* last visit.
6. *They speak very highly of-their* sugar *and* tea *and-we-shall give them a* trial.
7. *We-can deliver-the* wheels *in a* month's-time *if-you-will* allow *us to*-proceed *at once with-the* job.
8. *The* many *improvements which-you have* shown *us are very* valuable, *and should* help *to* increase *the* sales *of-the* glasses.
9. *Mr.* John Brown *of* 64 Rochester Avenue, Lincoln, *has* taken premises *at* 127 Castleton Road, Grimsby, *and-we-think-you-should-be able to* secure some *of-his* business.
10. Sir Thomas Harvey *has* taken *a* summer residence *in-the* neighbourhood *and*-proposes *to* attach *himself to-the* local Conservative Club.
11. Please arrange *to-be* here early *on*-Wednesday morning *to* discuss plans *for-the coming* autumn.
12. Learn *the* signs *for-the* grammalogues *and you-will-have much more satisfaction in-your* study *of-Phonography.*

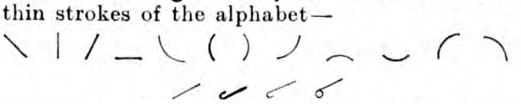
Key to Exercise 46



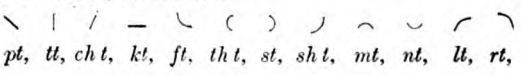
Key to Exercise 47



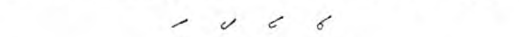
The Halving Principle.—Here are all the thin strokes of the alphabet—



If these strokes are halved in length, the letter *t* is added, as follows—



pt, tt, cht, kt, ft, tht, st, sht, mt, nt, lt, rt,



rt, wt, yt, ht.

Thus many words can be written by these short outlines, and in every case the word must end in the sound of *t.*

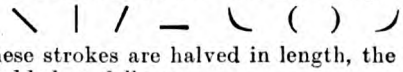
apt, pat, tight, chat, cat,

fat, shot, mat, neat, light.

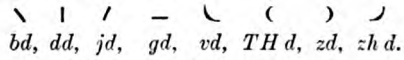
When a vowel follows the *t,* then the stroke *t* must be written; thus,

pity, chatty, Kitty, fatty.

Here are all the thick strokes of the alphabet—



If these strokes are halved in length, the letter *d* is added, as follows—



bd, dd, jd, gd, vd, TH d, zd, zh d.

And we write the words below as shown—

bad, died, avoid, eased.

When a vowel follows the *d,* then the stroke *d* must be written; thus,

body, dado, Judy, goody.

Consider the following outlines, and what do we notice about them?—

bent, bend; bout, bowed; rapid;

seated.

In the first, the halved stroke is finally hooked, and the outline stands for a word ending in *t,* and one ending in *d;* in the second, the halved stroke has a finally-joined diphthong, and the outline stands for a word ending

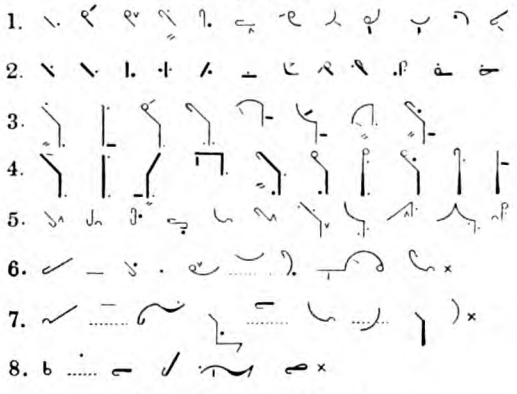
in *t*, and one ending in *d*; in the third, the halved stroke is joined to another stroke, and the *p* is halved to represent *d*; in the fourth, the *t* is halved for *d*, and the outline represents a word of two syllables. From these four examples, then, we learn that when a stroke is finally hooked, or has a finally-joined diphthong, or is joined to another stroke, or represents a word of more than one syllable, then that stroke may be halved either for *t* or *d*.

paint or *pained*; *tint* or *tinned*; *feud*, *rabbit*, *patted*; *stated*.

Exercise 48

GRAMMALOGUES

quite, *could*; *guard*, *great*; *greatest*.



Key to Exercise 48

1. pit, spot, spite, Pratt, treat, clout, soft, shut, shoots, note, art, yacht.
2. bed, bid, deed, aided, jade, egged, void, sobbed, stabbed, ceded, sagged, staggered.
3. Pattie, tattoo, spotty, pretty, motto, photo, Lottie, Plato.
4. body, daddy, Judy, gaudy, Breda, speed, steady, spade, tread, toad.
5. pound, tuned, trained, cleaned, feud, proud, appetite, fitted, routed, shifted, suited.
6. *We could* paint *the* sign *in* three colours *for-you*.
7. *You-are quite willing to*-take-*the guard if-you wish to-do so*.
8. *He-is a great general* among-*the greatest*.

Remember to use this Key as recommended in the earlier lessons.

Half-length H.—When half-length *h* stands alone, with or without a final circle or hook, the upward form is always written; thus,

hate, *hates*; *haunt*, *haunts*.

Half-length R.—The half-length *r* (upward), must not be written alone, or with final circle *s* only added; therefore, the strokes *r* and *t* must be written in words represented by upward *r* and *t*; thus,

rate, *rates*; *root*, *roots*.

The half-length form of *r* is written in such words as

rent, *rents*, *raft*, *rafts*,

where a final hook or circle *ns* is attached to the *r* halved. These restrictions are the outcome of practice and are insisted upon in order that distinctive outlines may be secured. The sign for *and* or *should* is very much like half-length upward *r*; and the sign for *rts*, if the half-length *r* were written, would be similar to the sign for *and-is*. Still bearing in mind the above restrictions in using the half-length strokes, the student should note that when a triphone immediately precedes *t* or *d*, the halving principle is not applied; thus, we write

quiet, *fiat*, *Jowett*.

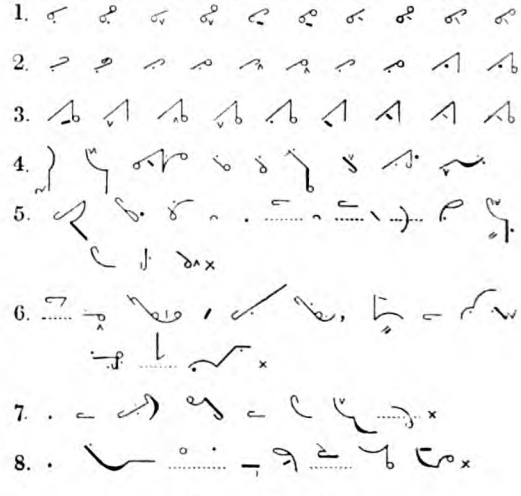
Word-Building.—The halving principle lends itself particularly to the building up of forms. The student should carefully note the subjoined examples—

pay, *pain*, *paint*, *paints*.
fay, *fain*, *faint*, *faints*.

Exercise 49

GRAMMALOGUES

accord-ing, *according to*, *cart*, *cared*; *called*, *equalled*, *cold*; *gold*.

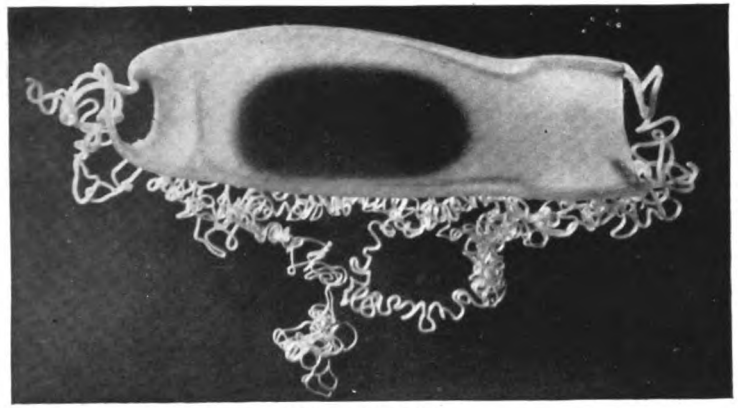


Exercise 50

GRAMMALOGUES

cannot; *not*; *happened*.

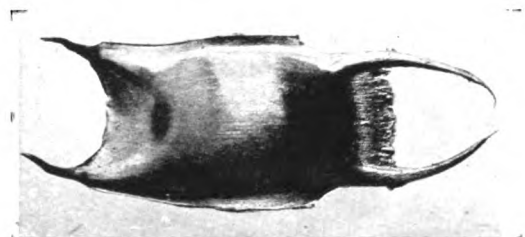
1. hate, hates, height, hunt, hunts, hind.
2. rift, roved, writ, wrote, rates, writes.
3. quiet, beds, bends, lends, doubt, patted, floated.
4. *We*-were-*not quite* ready *when-he called upon-us*.
5. *I happened to*-take-*the gold to-the* bank, *so it-was quite* safe.
6. *You-cannot* pay *too*-much attention *to-the* rules *on* halving.



Egg of Dog-fish.

Freshly deposited Dog-fish egg.

Egg of Ray. Side view.

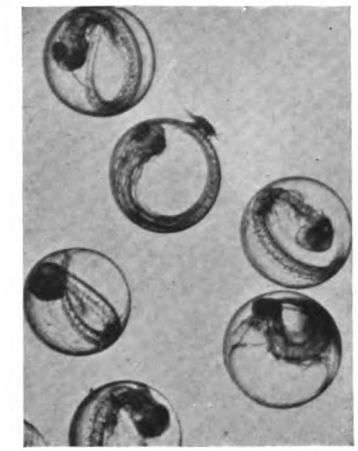


Egg of Ray. Full view.

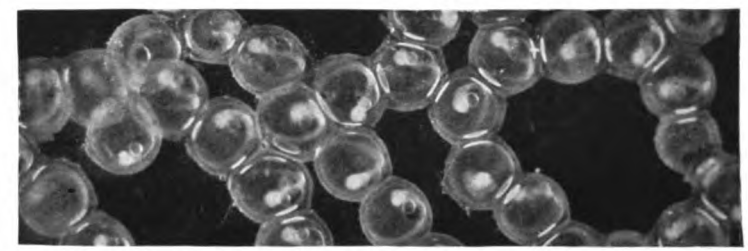
EGGS OF CARTILAGINOUS FISHES.

Heavy eggs of Salmon, unattached to each other.

Heavy eggs of Roach, attached to roots.



Floating eggs of Plaice.



Heavy eggs of Perch, attached to each other in ribbons.

EGGS OF BONY FISHES.

From photographs by Dr. Francis Ward, F.Z.S., F.R.P.S.

Continued from page 3.

ENGLISH LANGUAGE AND LITERATURE:

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THE NOVEL.—I

THE dating of the beginning of the British novel will always remain open for argument. In Elizabethan times romances were being written, as by Lyly and Sidney, Lodge and Greene; in the days of Charles II., by Mrs. Aphra Behn; and, later, Defoe developed the story of incident and adventure in a form of personal narrative that approximated to the novel.

It will, however, be admitted generally that the novel of character strung on a thread of love interest began with the publication, by Samuel Richardson, of *Pamela*, in 1740. From Richardson the sphere of the novel spread over all human life and character until it is by far the most prolific field of literary production.

Samuel Richardson

Samuel Richardson, a prosperous London printer, was over fifty years of age before he turned ambitiously to authorship. He was born in 1689, but where is doubtful. After a London apprenticeship to printing he started in the business on his own account, and won universal respect as an amiable, industrious, successful, and generous-minded citizen.

It was the age of letter-writing. To a large extent letters provided for the needs which later were to be satisfied by newspapers and light literature. They were the principal source of information, and of the materials for conversation, in a ceremonious age when manners, conversation, and correspondence were social arts.

Now honest Samuel Richardson, domestic, God-fearing and sentimental, prided himself on his expertness in the art of correspondence. Even as a youth he is said to have "corresponded with a gentleman of fortune who was a master of epistolary style." It occurred to two booksellers—or publishers as they would now be called—business associates of the printer, that it would be a good speculation to have a book of specimen letters that might be imitated by country readers and "persons of low quality," and Richardson was asked to undertake its composition. He, always seeking to promote moral aims, suggested that he should so indite the letters that they would "instruct the readers how to think and act justly in the common concerns of human life."

Starting with this object Richardson was quickly mastered by his own plan, and the letters grew into a story in two volumes, telling how a virtuous servant became the wife of her immoral master through resisting the temptations designed for her ruin. The letter-writing manual, deflected from its original purpose, became *Pamela, or Virtue Rewarded*, "in a series of familiar letters from a beautiful young damsel to her parents" (1740).

Pamela, or Virtue Rewarded

Two inferior volumes were afterwards added carrying Pamela's story further.

Instant and unprecedented success rewarded the kindly little printer. Four editions of the book were issued in six months. It became fashionable for ladies to carry the volumes in their hands, and letters from them, written on the author's own model, poured in upon him. One of the chief points of interest in *Pamela* to-day is that it shows us exactly what large numbers of people then needed. They resented the immoral tone that had infected literature and the stage after the Restoration. They were saturated with sentiment, in an age of abundant leisure. Here was a woman's man, a born sentimentalist, giving a minute

study of feminine character through the quiet, leisurely method of correspondence which harmonised with their own habits.

Eight years later Richardson published, in response to the urgent pleadings of his admirers, and still in letter form, a second novel, this time of middle-class life—*Clarissa, or the Adventures of a Young Lady*. His readers followed Clarissa Harlowe breathlessly through seven agonising volumes to a tragical ending.

Five years later still (1753), the novelist sketched, again in letter form, but with growing difficulty, for he was climbing beyond his own social experience, *The History of Sir Charles Grandison*, the perfect gentleman according to the standards of that period.

These novels, which seem to the average present-day reader tediously prolix and slow in development, not only won an enthusiastic response from the taste and conscience of the Englishmen, and especially the Englishwomen, for whom they were written, but they had a remarkable effect throughout Europe. There they gave a fresh impulse to the novel, and were widely imitated in style and spirit. Rousseau, for instance, the most vital literary force on the Continent, undoubtedly wrote his *Nouvelle Héloïse* under the direct influence of *Clarissa Harlowe*.

At home, too, later students of literature (like Macaulay), who are great devourers of books, undaunted by length or slowness of movement, have delighted in Richardson's accumulative effects.

Without in the least intending it, and partly because of the antagonisms he raised, Richardson was a notable pioneer. He died in 1761, honoured by his generation, and is buried in St. Bride's Churchyard, off Fleet Street, close by the site of his town house and printing office.

Henry Fielding

Henry Fielding, the greatest novelist of the eighteenth century, was directly instigated to write fiction by Richardson's *Pamela*. Born in Somerset, of the class of county people, in 1707, Fielding was educated at Eton, and then studied law for a year at Leyden; but finding himself left without means by the extravagance of his father, one of Marlborough's generals, he went to London and served the stage evanescently with comedies, farces, and burlesques. His first play was acted before he was twenty-one years of age. This early connection with the stage, lasting seven or eight years, has not added anything to his literary fame.

In 1734 he married the original of his heroines Sophia Western and Amelia—a charming West-country lady with a small fortune. After spending the money joyfully in the country, for he had an uneconomic mind, he went back to London to live by play-writing and political journalism while studying for the law. In 1740, the year when Richardson's *Pamela* was published, Fielding was called to the Bar.

It occurred to him that Richardson's story might be ludicrously parodied by reversing the sexes under temptation and making his virtuous hero Joseph Andrews the counterpart of Pamela; but as he wrote his characters took possession of him, particularly one, Abraham Adams, who became the first of a noble series in fiction of country parsons, to be continued through the works of later novelists. The result was a novel in two volumes, published in 1742, *The History and Adventures of Joseph Andrews and of his friend Mr. Abraham Adams*, which, though obviously a first attempt and amateurish, was a truer picture of "the ordinary life of ordinary people" than any book written up to that time in English.

History of Tom Jones

The next year Fielding published three volumes of *Miscellanies*, the last volume including a pungent satire, *The Life of Jonathan Wild the Great*, an ironical exposure of the pretentious forms of "greatness" which society then tolerated.

In 1745, after the death of his wife, Fielding reverted to journalism and started *The True Patriot*, denouncing the Jacobitism that was rife in connection with the activity of the Young Pretender. Two years later it became *The Jacobite Journal*. For these services to the Government he was appointed a paid magistrate for Westminster and for Middlesex in 1748.

As a magistrate he was industrious, thoughtful, and public-spirited, and had an influence in shaping the current policy for the restraint of crime. Simultaneously with his magisterial work he continued the writing which had become the distinctive feature of his life.

Early in 1749 appeared, in six volumes, the masterpiece *The History of Tom Jones, a Foundling*. *Amelia*, in four volumes, published in 1752, showed signs of declining vitality, and two years later Fielding's health, long precarious, appeared hopelessly shattered. Accompanied by his

second wife, who had been maid to his first wife and had tenderly brought up his family, he set out, as a last hope, for a voyage to Lisbon. There he died, October 8th, 1754. His *Journal of a Voyage to Lisbon*, written under the shadow of death, and published posthumously, is a pathetic record of a brave and high-spirited man living life out to the very end.

Fielding's novels are often out of tune with the reticence of the twentieth century because they depict in fullest candour the low moral tone of the eighteenth century. Though he always makes it clear that immorality is at least a mistake, and hypocrisy an outrage, Fielding brings licence into his pictures as a matter of course. The brutal vulgarity of the typical rough squire of his day gives him no qualms. Because coarseness was true he sees no reason why he should not let it appear in his pages without reserve.

With a dauntless eye he surveys a wide range of life, and sketches it all in a spirit of toleration, persistent good humour, and with a morality that remains sound at heart in a contaminated age. His writings form one of the most important records of the history of his times in England.

From the literary point of view Fielding's handling of his subjects is bold and free; he has a manly breadth and ease, taking his place naturally in the very centre of the field of fiction, while his contemporaries were working in corners of the field. Richardson had invented a form of the novel, at which he worked cramped in feeling and stilted in style, while Smollett was crude and coarse, and Sterne effeminate and thin. Fielding turned all eyes on the life of the average man, while he idolised the exceptional woman.

His method and spirit have influenced later novelists greatly. Thackeray, for instance, accepted him as his model, even to the trick of taking up a position as a bystander and commenting on the creatures of his imagination. Above all, Fielding staked out the "claim" of fiction, and made it include the whole world of men.

HENRY FIELDING (1707-54)

A rough sketch by Hogarth of the greatest novelist of the eighteenth century. Reproduced from Murphy's edition of Fielding's works, 1772.

The third member of the trio who founded the English novel in the eighteenth century was Tobias George Smollett, a Scottish doctor of coarsely vigorous mind, who deserted medicine for literature, and, amongst voluminous writings, left behind three stories that will always be read by students of the century—*The Adventures of Roderick Random*, *The Adventures of Peregrine Pickle*, and *The Expedition of Humphry Clinker*.

Smollett was born in Dumbartonshire, in 1721, of a family of some repute, and brought up by his grandfather Sir James Smollett, who, however, died when the lad was in his teens. Apprenticeship to a doctor gave him some preliminary medical training, but at the age of eighteen he made his way to London with a tragedy in his pocket which, to his chagrin, no one would publish or produce. Joining the navy as a surgeon, he sailed for the West Indies and served at the siege of Cartagena. Retiring from the

navy, he set up in London as a doctor, married a Jamaica heiress with disappointing means, and varied medicine with satirical writing for the press.

In 1748 appeared his *Roderick Random*, a discursive tale, based partly on his own experiences, and written admittedly in imitation of Le Sage's *Gil Blas*. In 1750 the M.D. degree was granted the novelist at Aberdeen, but at no time was his practice as a doctor a pecuniary success. After the publication of *Peregrine Pickle* in 1751, and *Count Ferdinand Fathom* in 1754, medicine was forsaken, and for ten strenuous years Smollett lived the life of a busy and successful man of letters—writing or editing for the book-buyer of his period the kind of informational books that were in demand, and organising a group of assistants engaged in similar work.

Tobias Smollett

As an editor of literary reviews and political party organs he was a savage wielder of the literary tomahawk and was constantly embroiled in bitter feuds. He took part in the translation of Voltaire and Le Sage; helped to compile a Universal History and a Compendium of Travel; and wrote, hastily, a *History of England*, fluent in expression but of no value.

Then, his health failing, he lived for about two years on the Riviera and helped to establish the fame of Nice and Cannes as resorts for ailing people. His *Travels*, which are still reprinted, appeared in 1766, when he returned home and was received with honour in the literary circles of Scotland. Nothing, however, sweetened his spirit, and he wrote a savage satire, *The History and Adventures of an Atom*, in which he caustically and vulgarly lampooned the politicians of his day.

His health breaking up again, he returned south in 1769, settling near Leghorn, where he died in the autumn of 1771. In these last two years he wrote the most mellow and humane of his books, *Humphry Clinker*, news of its success reaching him on his death-bed.

Smollett lives only through his novels; and they have graver and more positive defects than any contemporary stories that survive. Putting aside *Humphry Clinker*, the character on whom the story in each instance centres is a rascal, without the author knowing it. The tone is uniformly low. Even *Humphry Clinker*, the one redeeming story, written when its author must have known his life was drawing towards its end, is coarse in parts beyond the coarseness of its age.

Why is it that Smollett, with these disadvantages, has had a clearly marked influence on later novelists whose work was pure? His better qualities will appear if we note who these imitators are.

First, he was the originator of the seafaring man of the story-books. His Tom Bowling and others in *Roderick Random*, his Commodore Trunnion and others in *Peregrine Pickle*, gave the sailorman a place in the middle of the stage which he has never lost. Fanny Burney, Marryat, and Lever were manifest copyists of Smollett's seamen afloat and ashore.

Then Smollett could outline a character with remarkable clearness, vigour, and precision, making it intensely real with a comparatively few strokes, and his character-drawing has influenced later masters of the art of clear-cut portraiture. Commodore Trunnion, Matthew Bramble, Lismahago—the last two in *Humphry Clinker*—live.

Laurence Sterne

Sterne became an immediate imitator; Scott palpably followed with some of his most distinctive characters; and Dickens long remained an open disciple of the novelist whose sardonic spirit was in greatest contrast with his own. The wanderings of Mr. Pickwick, without a plan, into casual encounters, and limning of the people met by their eccentricities, is Smollett's method worked by Dickens with infinite good-nature.

Strength and movement hustle, rough and crude, and without decency, through the pages of Smollett. It is the loud laugh he seeks. But the genuine groundwork of his humour, underneath his boisterousness and bitterness, the substratum of rough humanity in his character, appears at last in *Humphry Clinker*. He was the strong man among these eighteenth-century novelists, but grievously warped.

Laurence Sterne, a North-country clergyman and Prebendary of York, is usually classified as a novelist, but that is because his works will not fit into any other category. Rather than novels they are rambling sketches with human character as their main theme, but admitting of untrammelled wandering, without a goal.

From the point of view of personal character no writer after the libertine days of the Restoration drama creates less respect than Sterne, though he was a clergyman.

On his father's side his family was in general good repute. His great-grandfather

FOUR EIGHTEENTH CENTURY NOVELISTS.

1. **Horace Walpole (1717-1797).** (*From the portrait by J. G. Eccardt. Photo: Emery Walker.*)
2. **Tobias Smollett (1721-1771).** (*From a portrait by an Italian artist. Photo: Emery Walker.*)
3. **Samuel Richardson (1689-1761).** (*From the portrait by J. Highmore.*)
4. **Laurence Sterne (1713-1768).** (*From the portrait by Gainsborough in the Salfora Art Galleries.*)

had been Archbishop of York. His father was an impecunious officer who married a daughter of the regimental caterer; and for the first ten years of his boyhood (1713–1723) Sterne was trailed in the wake of the regiment from place to place. Then a Yorkshire relative took the lad, had him educated, and sent him to Cambridge to the College (Jesus) where his most noted ancestor had been the first Master. At Cambridge Sterne's chief friend was a Yorkshire squire notorious for his boisterousness and obscenity.

Joining the Church, Sterne soon accumulated, through family influence and marriage, a series of small preferments in Yorkshire, where he kept up his acquaintance with his undesirable college friend. Nothing can be said for Sterne as a parson.

Tristram Shandy

Not till he was forty-six (1760) did he make his mark by writing the first volumes of *Tristram Shandy*, a diffuse history of a supposed family. Written with colloquial ease, abounding in subtle humour and deliberate approaches to indecency, the book became at once immensely popular, and its author was hailed in London as a literary "lion," a character he could support with much applause by his witty conversation.

Sterne said with truth that there was no reason why he should not go on writing two more such desultory volumes every year for forty years. As a matter of fact, in nine years he extended the volumes to nine, and then ceased adding to them partly because of ill-health. His travels in search of health led to the writing of his *Sentimental Journey*, published in 1768, the year of his death in London.

All personal relationships—as with his mother, sister, wife, and daughter—were unsatisfactory. His mother and sister shunned him and were forsaken by him, perhaps not without cause; his wife was separated from him and took their daughter with her; and the daughter, after his death, threatened to blackmail women who had been so foolish as to engage in sentimental correspondence with him.

He quarrelled with the more respectable members of his family, who had given him his start in life. The only friends, of a sort, whom he retained were the coarse squires who were his neighbours, and the leaders of fashionable London Society whose invitations were the crown of his desires, and who laughed at his wit but left him to die alone and be buried with a single mourner.

This state of things was a natural consequence of the satirist's conduct. Of a hysterical temperament, a slave to impulse, almost devoid of moral feeling, revelling in the vanity of amorous conquests, Sterne, though in the Church, had not a rag of character. His sly and calculating indecency was far worse than Smollett's coarseness. Why, then, should his writings still be admired and, apart from their blots, be imitated?

They had a whimsical humour which appealed to the spirit of the period, and a skilfully accumulated sentimentality that harmonised with and stimulated a prevailing fashion; and they introduced several distinctive characters, such as Uncle Toby and Corporal Trim, when character-drawing in fiction was only in its infancy. Further, though Sterne's style in writing was often freakish and affected, it was also, on occasion, bright and lucid in a high degree. Though amazingly clever the man was only a fashion-maker; he had neither enough humanity nor enough sincerity to make a lasting impression, except that he was an expert stylist in a way of his own.

The overdone sentiment which appealed to Sterne's generation has been revived from time to time and has found a public that was temporarily appreciative, as in the reception of Charles Dickens's overwrought Little Nell in *The Old Curiosity Shop*.

Vicar of Wakefield

It has been noted that the rise of the novel, as the term is now understood, began in the 'forties of the eighteenth century, when Richardson, Fielding, and Smollett were all writing. All continued writing well into the 'fifties; and Sterne prolonged the movement by his semi-novels through the 'sixties. It was closed finally by Smollett's belated *Humphry Clinker* in 1771. During the 'sixties two other novels were written, one of which—Horace Walpole's *Castle of Otranto*, published in 1765—deserves to be mentioned because of its influence on later novelists, and the other—Oliver Goldsmith's *Vicar of Wakefield*, published in 1766—because of its intrinsic worth. After these stories, with the exception of Smollett's last isolated effort, not a single novel written by men merits remembrance until Scott's *Waverley* appeared in 1814.

For nearly fifty years the continuation and development of the novel, in so far as it was marked by merit, passed into the hands of women writers. For nearly a century and a half women have been more prolific in the production of fiction than men, and have

sustained comparison with them on the highest literary levels with a success far exceeding their attainments in any other branch of literature.

Before the course of this feminine triumph is traced a glance must be given at the two novels just mentioned.

Horace Walpole, third son of Sir Robert Walpole, and fourth Earl of Orford, born in 1717, was a man of varied and genuine literary facility, a historian, biographer, critic, letter-writer, and amateur painter. When he became a novelist and wrote his *Castle of Otranto* he had a distinct object in view—the new infusion of romance into fiction that had become exclusively domestic.

Goldsmith's immortal *Vicar of Wakefield*, published in 1766, but written four years earlier, won its way gradually to the position of a classic by its tenderness, humour, and quaint simplicity.

According to popular tradition, the story came to be published in this way. In 1765 Goldsmith—as ever in sore financial straits—had so overtaxed his landlady's patience that the good woman invoked the aid of the sheriff's officer. Goldsmith, in despair, sent an urgent plea for help to Dr. Johnson. The doctor replied by sending a guinea and promising to come in person as soon as possible.

From the Picture by E. M. Ward, R.A.

DR. JOHNSON RESCUING GOLDSMITH

from his landlady who, her patience overtaxed by long non-payment of rent, had called in the sheriff's officer. It was then—so runs the story—that Goldsmith produced the MS. of *The Vicar of Wakefield*.

In due course he arrived at the house. There he found Goldsmith drinking sherry (which he had bought with the guinea) and haranguing the landlady. The doctor called his friend to reason, and proceeded to discuss with him ways and means. And it was then that the thriftless writer produced the manuscript of *The Vicar of Wakefield*.

From a century that, according to its fiction, regarded seduction as the chief amusement of men of fashion, comes this novel which never for a moment allows the boundaries between licentiousness and manly virtue to be obliterated or mistaken. J. D.

Drawn by A. Forestier.

THE INVESTITURE OF CHARLES, PRINCE OF WALES, NOVEMBER, 1616.

The unlucky prince, destined later to lose both his crown and head, became heir-apparent in 1612 on the death of his elder brother, Henry, who had given promise of a brilliant future.

Continued from page 8.

HISTORY:

Contributors:—J. A. Brendon, B.A.(Oxon.), F.R.Hist.S.; F. Collinson, F.R.Hist.S.; T. P. Evans, B.A.(Oxon.); James A. Manson; L. Stampa, M.A.(Oxon.); and J. B. Sterndale-Bennett.

BRITAIN'S STORY.— X

[*The introductory chapter of* LORD MACAULAY'S "*History of England*" *has been adopted in this work to explain the development of the British race prior to* 1660. *But as Lord Macaulay's work was intended merely as a sketch, explanatory passages* (*printed in closer type*) *have been interpolated in order to meet the requirements of the student.*]

IN the year 1603 Elizabeth died.

That year is, on many accounts, one of the most important epochs in our history. It was then that both Scotland and Ireland became parts of the same empire with England.

Both Scotland and Ireland, indeed, had been subjugated by the Plantagenets; but neither country had been patient under the yoke. Scotland had, with heroic energy, vindicated her independence, had, from the time of Robert Bruce, been a separate kingdom, and was now joined to the southern part of the island in a manner which rather gratified than wounded her national pride.

Stuart Ireland—

Ireland had never, since the days of Henry II., been able to expel the foreign invaders; but she had struggled against them long and fiercely. During the fourteenth and fifteenth centuries the English power in that island was constantly declining, and, in the days of Henry VII. sank to the lowest point. The Irish dominions of that prince consisted only of the counties of Dublin and Louth, of some parts of Meath and Kildare, and of a few seaports scattered along the coast. A large portion even of Leinster was not yet divided into counties. Munster, Ulster, and Connaught were ruled by petty sovereigns, partly Celts, and partly degenerate Normans, who had forgotten their origin and had adopted the Celtic language and manners.

But, during the sixteenth century, the English power had made great progress. The half savage chieftains who reigned beyond the pale had submitted one after another to the lieutenants of the Tudors. At length, a few weeks before the death of Elizabeth, the conquest, which had been begun more than four hundred years before by Strongbow, was completed by Mountjoy.

Scarcely had James I. mounted the English throne when the last O'Donnel and O'Neil who have held the rank of independent princes kissed his hand at Whitehall. Thenceforward his writs ran and his judges held assizes in every part of Ireland; and the English law superseded the customs which had prevailed among the aboriginal tribes.

—and Scotland: A Contrast

In extent Scotland and Ireland were nearly equal to each other, and were together nearly equal to England, but were much less thickly peopled than England, and were very far behind England in wealth and civilisation. Scotland had been kept back by the sterility of her soil; and, in the midst of light, the thick darkness of the middle ages still rested on Ireland.

The population of Scotland, with the exception of the Celtic tribes which were thinly scattered over the Hebrides and over the mountainous parts of the northern shires, was of the same blood with the population of England, and spoke a tongue which did not differ from the purest English more than the dialects of Somersetshire and Lancashire differed from each other. In Ireland, on the contrary, the population, with the exception of the small English colony near the coast, was Celtic, and still kept the Celtic speech and manners

In natural courage and intelligence both the nations which now became connected with England ranked high. In perseverance, in self-command, in forethought, in all the virtues which conduce to success in life, the Scots have never been surpassed. The

Irish, on the other hand, were distinguished by qualities which tend to make men interesting rather than prosperous. They were an ardent and impetuous race, easily moved to tears or to laughter, to fury or to love. Alone among the nations of northern Europe they had the susceptibility, the vivacity, the natural turn for acting and rhetoric, which are indigenous on the shores of the Mediterranean Sea.

In mental cultivation Scotland had an indisputable superiority. Though that kingdom was then the poorest in Christendom, it already vied in every branch of learning with the most favoured countries.

Scotsmen, whose dwellings and whose food were as wretched as those of the Icelanders of our time, wrote Latin verse with more than the delicacy of Vida, and made discoveries in science which would have added to the renown of Galileo. Ireland could boast of no Buchanan or Napier. The genius, with which her aboriginal inhabitants were largely endowed, showed itself as yet only in ballads which, wild and rugged as they were, seemed to the judging eye of Spenser to contain a portion of the pure gold of poetry.

Irish Grievances

Scotland, in becoming part of the British monarchy, preserved her dignity. She gave a King instead of receiving one. She retained her own constitution and laws.

Ireland, on the other hand, was undisguisedly governed as a dependency won by the sword. The parliaments which met at Dublin could pass no law which had not been previously approved by the English Privy Council. The authority of the English legislature extended over Ireland. The executive administration was entrusted to men taken either from England or from the English pale, and, in either case, regarded as foreigners, and even as enemies, by the Celtic population.

But the circumstance which, more than any other, has made Ireland to differ from Scotland remains to be noticed.

Scotland was Protestant. In no part of Europe had the movement of the popular mind against the Roman Catholic Church been so rapid and violent. The Reformers would not endure even such a compromise as had been effected in England. They had established the Calvinistic doctrine, discipline and worship; and they made little distinction between Popery and Prelacy, between the Mass and the Book of Common Prayer.

Unfortunately for Scotland, the prince whom she sent to govern a fairer inheritance had been so much annoyed by the pertinacity with which her theologians had asserted against him the privileges of the synod and the pulpit that he hated ecclesiastical policy to which she was fondly attached as much as it was in his effeminate nature to hate anything, and had no sooner mounted the English throne than he began to show an intolerant zeal for the government and ritual of the English Church.

The Irish were the only people of northern Europe who had remained true to the old religion. This is to be partly ascribed to the circumstance that they were some centuries behind their neighbours in knowledge. But other causes had co-operated. The Reformation had been a national as well as a moral revolt. It had been, not only an insurrection of the laity against the clergy, but also an insurrection of all the branches of the great German race against an alien domination.

Language and Creed

It is a most significant circumstance that no large society of which the tongue is not Teutonic has ever turned Protestant, and that, wherever a language derived from that of ancient Rome is spoken, the religion of modern Rome to this day prevails. The patriotism of the Irish had taken a peculiar direction. The object of their animosity was not Rome, but England; and they had especial reason to abhor those English sovereigns who had been the chiefs of the great schism, Henry VIII. and Elizabeth. The new feud of Protestant and Papist inflamed the old feud of Saxon and Celt.

The English conquerors, meanwhile, neglected all legitimate means of conversion. No care was taken to provide the vanquished nation with instructors capable of making themselves understood. No translation of the Bible was put forth in the Irish language. The government contented itself with setting up a vast hierarchy of Protestant archbishops, bishops, and rectors, who did nothing, and who, for doing nothing, were paid out of the spoils of a Church loved and revered by the great body of the people.

There was much in the state both of Scotland and of Ireland which might well excite the painful apprehensions of a far-sighted statesman. As yet, however, there was the appearance of tranquillity.

For the first time all the British isles were peaceably united under one sceptre.

It should seem that the weight of England among European nations ought, from this epoch, to have greatly increased. The territory which her new King governed was,

in extent, nearly double that which Elizabeth had inherited. His empire was the most complete within itself and the most secure from attack that was to be found in the world.

The Plantagenets and Tudors had been repeatedly under the necessity of defending themselves against Scotland while they were engaged in continental war. The long conflict in Ireland had been a severe and perpetual drain on their resources. Yet even under such disadvantages those sovereigns had been highly considered throughout Christendom. It might, therefore, not unreasonably be expected that England, Scotland, and Ireland combined would form a state second to none that then existed.

From the portrait by Van Dyck.

KING JAMES VI. OF SCOTLAND AND JAMES I. OF ENGLAND,

whom Henry IV. of France described as "the wisest fool in Christendom." History has confirmed this opinion.

All such expectations were strangely disappointed. On the day of the accession of James I. England descended from the rank which she had hitherto held, and began to be regarded as a power hardly of the second order. During many years the great British monarchy, under four successive princes of the House of Stuart, was scarcely a more important member of the European system than the little kingdom of Scotland had been.

This, however, is little to be regretted. Of James I., as of John, it may be said, that if his administration had been able and splendid, it would probably have been fatal to our country, and that we owe more to his weakness and meanness than to the wisdom and courage of much better sovereigns.

The time was fast approaching when either the King must become absolute, or the Parliament must control the whole executive administration. Had James been, like Henry IV., or like Gustavus Adolphus, a valiant, active, and politic ruler, had he put himself at the head of the Protestants of Europe, and had he found himself, after great achievements, at the head of fifty thousand troops devotedly attached to his person, the English Parliament would soon have been nothing more than a name.

Happily he was not a man to play such a part. He began his administration by putting an end to the war which had raged during many years between England and Spain; and from that time he shunned hostilities with a caution which was proof against the insults of his neighbours and the clamours of his subjects. The effect of his pacific policy was that, in his time, no regular troops were needed, and that, while France, Spain, Italy, Belgium, and Germany swarmed with mercenary soldiers, the defence of our island was still confided to the militia.

As the King had no standing army he would have been wise to avoid any conflict with his people. But such was his indiscretion that, while he altogether neglected the means which alone could make him really absolute, he constantly put forward claims of which none of his predecessors had ever dreamed.

It was at this time that those strange theories which became the badge of the most violent class of Tories and high churchmen, first emerged into notice.

It was gravely maintained that the Supreme Being regarded hereditary mon-

archy, as opposed to other forms of government, with peculiar favour; that the rule of succession in order of primogeniture was a divine institution, anterior to the Christian, and even to the Mosaic dispensation; that no human power, not even that of the whole legislature, no length of adverse possession, though it extended to ten centuries, could deprive a legitimate prince of his rights; that the authority of such a prince was necessarily always despotic; that the laws by which, in England and in other countries, the prerogative was limited, were to be regarded merely as concessions which the sovereign had freely made and might at his pleasure resume; and that any treaty which a king might conclude with his people was merely a declaration of his present intentions, and not a contract of which the performance could be demanded.

Divine Right

It is evident that this theory, though intended to strengthen the foundations of government, altogether unsettles them. Does the divine and immutable law of primogeniture admit females, or exclude them? On either supposition half the sovereigns of Europe must be usurpers, reigning in defiance of the law of God, and liable to be dispossessed by the rightful heirs. The doctrine that kingly government is peculiarly favoured by Heaven receives no countenance from the Old Testament.

Nor does the system of Filmer receive any countenance from those passages of the New Testament which describe government as an ordinance of God; for the government under which the writers of the New Testament lived was not a hereditary monarchy.

The Roman Emperors were republican magistrates, named by the senate. None of them pretended to rule by right of birth; and, in fact, both Tiberius, to whom Christ commanded that tribute should be given, and Nero, whom Paul directed the Romans to obey, were, according to the patriarchal theory of government, usurpers. In the middle ages the doctrine of indefeasible hereditary right would have been regarded as heretical; for it was altogether incompatible with the high pretensions of the Church of Rome. It was a doctrine unknown to the founders of the Church of England.

Indeed most of the predecessors of James would, from personal motives, have regarded the patriarchal theory of government with aversion. William Rufus, Henry I., Stephen, John, Henry IV., Henry V., Henry VI., Richard III., and Henry VII., had all reigned in defiance of the strict rule of descent. A grave doubt hung over the legitimacy both of Mary and of Elizabeth. It was impossible that both Catherine of Aragon and Anne Boleyn could have been lawfully married to Henry VIII.; and the highest authority in the realm had pronounced that neither was so.

The Tudors, far from considering the law of succession as a divine and unchangeable institution, were constantly tampering with it. Henry VIII. obtained an act of parliament, giving him power to leave the crown by will, and actually made a will to the prejudice of the royal family of Scotland. Edward VI., unauthorised by Parliament, assumed a similar power, with the full approbation of the most eminent Reformers. Elizabeth, conscious that her own title was open to grave objection, and unwilling to admit even a reversionary right in her rival and enemy the Queen of Scots, induced the Parliament to pass a law, enacting that whoever should deny the competency of the reigning sovereign, with the assent of the Estates of the realm, to alter the succession, should suffer death as a traitor.

King James I

But the situation of James was widely different from that of Elizabeth. Far inferior to her in abilities and in popularity, regarded by the English as an alien, and excluded from the throne by the testament of Henry VIII., the King of Scots was yet the undoubted heir of William the Conqueror and of Egbert. He had, therefore, an obvious interest in inculcating the superstitious notion that birth confers rights anterior to law, and unalterable by law. It was a notion, moreover, well suited to his intellect and temper. It soon found many advocates among those who aspired to his favour, and made rapid progress among the clergy of the Established Church.

Thus, at the very moment at which a republican spirit began to manifest itself strongly in the Parliament and in the country, the claims of the monarch took a monstrous form which would have disgusted the proudest and most arbitrary of those who had preceded him on the throne.

James was always boasting of his skill in what he called kingcraft; and yet it is hardly possible even to imagine a course more directly opposed to all the rules of kingcraft than that which he followed. The policy of wise rulers has always been to disguise strong acts under popular forms.

Drawn by A. Forestier.

WATCHING HIS GREAT-GRAND-UNCLE.

James I., an enthusiastic patron of the drama, witnessing a "command" performance of *King Henry VIII.* by Shakespeare's Company of "King's Servants" in the Banqueting House of Whitehall Palace when, even at this early date, that mechanism and those accessories which go to make up stage-craft were—despite a common belief to the contrary—by no means unknown.

It was thus that Augustus and Napoleon established absolute monarchies, while the public regarded them merely as eminent citizens invested with temporary magistracies.

The policy of James was the direct reverse of theirs. He enraged and alarmed his Parliament by constantly telling them that they held their privileges merely during his pleasure, and that they had no more business to inquire what he might lawfully do than what the Deity might lawfully do. Yet he quailed before them, abandoned minister after minister to their vengeance, and suffered them to tease him into acts directly opposed to his strongest inclinations. Thus the indignation excited by his claims and the scorn excited by his concessions went on growing together.

A Common Enemy

In the meantime the religious dissensions by which, from the days of Edward VI., the Protestant body had been distracted, had become more formidable than ever.

While the recollection of Mary's cruelties was still fresh, while the powers of the Roman Catholic party still inspired apprehension, while Spain still retained ascendancy and aspired to universal dominion, all the reformed sects knew that they had a strong common interest and a deadly common enemy. The animosity which they felt towards each other was languid when compared with the animosity which they all felt towards Rome.

The Established Church

But when more than half a century of undisturbed possession had given confidence to the Established Church, when nine-tenths of the nation had become heartily Protestant, when England was at peace with all the world, and when there was no danger that Popery would be forced by foreign arms on the nation, a change took place in the feeling of the Anglican clergy. Their hostility to the Roman Catholic doctrine and discipline was considerably mitigated. Their dislike of the Puritans, on the other hand, increased daily. The controversies which had from the beginning divided the Protestant party took such a form as made reconciliation hopeless; and new controversies of still greater importance were added to the old subjects of dispute.

From a Dutch Engraving in the National Portrait Gallery. Photo by Emery Walker.

THE GUY FAWKES CONSPIRATORS.

The so-called Gunpowder Plot was the project of a few Roman Catholics who conspired to destroy James I. and with him the Lords and Commons, assembled in the Houses of Parliament, on 5th of November, 1605. The plot originated with Robert Catesby. Guy Fawkes undertook to fire the gunpowder which had been concealed in a vault under the House of Lords. The plot was betrayed in an anonymous letter. The vault was preserved as "Guy Fawkes' Cellar" till 1825, when it was converted into offices.

Continued from page 23.

SCIENCES:

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SOUND.—III

9. Pitch and its Measurement. — In Savart's toothed wheel we have a simple method of measuring pitch which is difficult practically, owing to the difference in quality between the notes to be compared, and equally owing to the difficulty of maintaining the note constant. Various improvements on the method have been made, the most successful being the substitution of puffs of air for the teeth of the wheel.

The disc siren is a simple application of this. It consists of a metallic disc in which three or four rings of holes are pierced at equal intervals; the disc is set in motion round its centre, and a nozzle is directed towards one or other of the rings of holes. On blowing air through the nozzle, a note is heard whose pitch can be regulated by varying the rate of revolution of the disc. Each puff of air through a hole starts a wave, and the series of puffs at equal intervals causes a train of waves giving sound (Fig. 16).

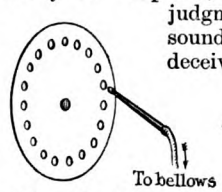


Fig. 16.—The disc siren.

Caignard de la Tour's Siren is a more complicated instrument depending on the same principle. The air is blown into a cylindrical wind-chest, the top of which is perforated with rings of equidistant holes, which are cut obliquely but all in the same direction. Above this is a circular disc which is able to move freely on a pivot in its centre; it is also provided with the rings of holes, which correspond exactly with those of the wind-chest. These holes are also bored obliquely, but in the opposite direction to those of the bottom disc. Thus, the air coming through the lower set of holes is made to set the upper disc into rotation, and a sound is produced by the rapid succession of puffs.

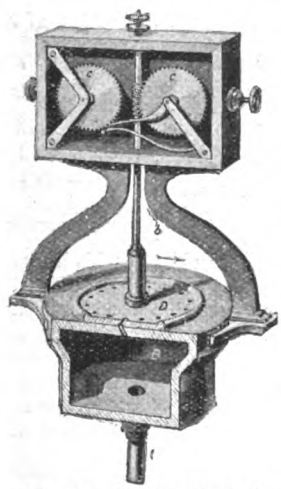


Fig. 17.—Caignard de la Tour's siren.

The revolving disc has its axis connected with a counting arrangement, by which the rate of revolution can be read on a clock-face. The main difficulty in using the siren is connected with the steadiness of the air-supply, but a result of very reasonable accuracy can be obtained with it. It depends, however, on the formation of an accurate judgment of the equal pitch of two notes sounding together, and ears can be easily deceived.

When two notes have frequencies close together, say 300 and 304, a very unpleasant discord is noticed between them, which is not always so noticeable when the gap between them is wider. This is due to the production of what we call *beats*, definite rises and falls of sound, equal in number to the difference between the frequencies. Thus, in the case suggested, there would be four beats per second, and these can quite easily be counted. But it is not at all easy to decide by ear which of the two notes is the higher. If an increase in the rate of the siren reduces the number of beats per second, it is, however, clear that the other note was the higher, and that the point at which harmony is obtained on increasing the air-pressure gives the right frequency as nearly as the instrument can.

The principle of beats is made use of in the *tonometer*, which consists of a series of tuning-forks between the limits of an octave. The octave of a note has twice its frequency, and can be very accurately judged by ear. Now suppose we have a series of tuning-forks so arranged that between any successive pair four beats can be counted, and that the extreme members of the series form an octave of frequencies n and $2n$. If the number of forks were, say, 61, the frequencies of the forks

would then be n, $n+4$, $n+8$, $n+12$, ... $n+60\times4$; and the last one $n+240=2n$. Hence, $n=240$, and the frequencies of the whole series will be known, and the frequency of any note within its range could be found by comparison with one of the forks.

A less tedious and very accurate method, and one not dependent on the ear, is the smoked-glass method (Fig. 18). If a very light pointer be attached to a prong of a vibrating tuning-fork, and the fork rapidly drawn along a sheet of smoked glass with the pointer lightly touching it, a wavy line is traced. As each complete wave corresponds to a vibration of the fork, it is evident that if we knew the rate at which the fork is moved we could determine its pitch by counting the waves. The problem is solved by having the vibrating fork fixed, and allowing the wavy line to be traced on a revolving drum whose rate of revolution can be determined. In a modification of the method, the latter measurement is avoided by an electrical device which causes the line to be broken at regular intervals of, say, half a second. The method, being entirely mechanical, is susceptible of great accuracy.

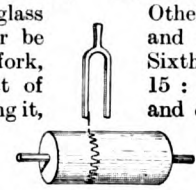
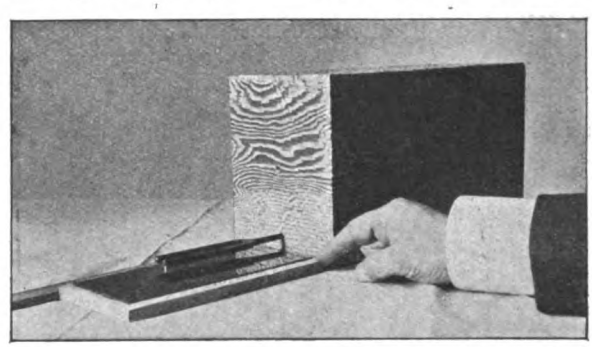


Fig. 18.—The smoked glass method of determining pitch.

Other methods dependent on vibrating strings or other principles will be discussed in subsequent lessons.



A graphic representation of the vibrations of a tuning-fork may be obtained by passing a sheet of smoked glass under the fork which, in order to do the tracing, should have attached to it a tiny point of metallic foil.

The range of audibility varies with the observer, the maximum range being somewhere between 24 and 32,000 vibrations per second. Few individuals can perceive a note so low as 24 as a continuous musical note, and vibrations as rapid as 24,000 per second are probably lost to most ears. But there are wide differences in auditory perception; to some people the chirp of the grasshopper is inaudible.

10. Musical Intervals—The Diatonic Scale.—It is well known that certain notes when sounded together produce harmony, while others do not blend in a pleasing way at all. So, too, when two notes are sounded in succession, the effect is sometimes pleasing, but not always. The continuous rise or fall of pitch is entirely disagreeable, as we hear it in a sigh or in the moaning of the wind. The mind demands an *interval* between successive notes, and the interval is only pleasant when the ratio of the two frequencies is simple. Thus the frequency ratio $\frac{384}{256}\left(=\frac{3}{2}\right)$ is simple, and gives an agreeable musical interval, as well as harmony. The ratio $\frac{387}{256}$ is complex, and the result is discord.

It is a curious fact, not explainable by physical causes, that the notes which are harmonious together are those which form the most agreeable musical intervals.

The most familiar musical interval is the *Octave* (2 : 1). Almost as easy to recognise are the *Fifth* (3 : 2) and the *Major Third* (5 : 4). On the scale of C, these form the notes E (Major Third), G (Fifth) and *c* : in Tonic Sol-fa notation, *doh, me, soh, doh.*

Other pleasing intervals are those between C and F (*fah*, Fourth, 4 : 3); C and A (*lah*, Major Sixth, 5 : 3); C and D (*ray*, 9 : 8); C and B (*te*, 15 : 8); A and *c* (Minor Third, 6 : 5); and E and *c* (Minor Sixth, 8 : 5).

The succession of eight notes, including the major intervals just mentioned, forms the well-known *diatonic scale*, so familiar to us as to be accepted almost as a natural fact, though of course we have had to educate ourselves to it. Starting from C as the *tonic* or keynote of the scale, the scale with its vibration ratios runs :—

C	D	E	F	G	A	B	*c*
1	$\frac{9}{8}$	$\frac{5}{4}$	$\frac{4}{3}$	$\frac{3}{2}$	$\frac{5}{3}$	$\frac{15}{8}$	2

e.g. 256, 288, 320, 341⅓, 384, 426⅔, 480, 512

The intervals C—D, F—G, A—B $\left(\frac{9}{8}\right)$ form major tones; D—E, G—A $\left(\frac{10}{9}\right)$ are minor tones; E—F and B—*c* $\left(\frac{16}{15}\right)$ are major semitones.

If the keynote is changed, it will be found that fresh notes are needed if the frequency ratios are to be kept up. Thus, if D = 288 is the keynote, the scale becomes

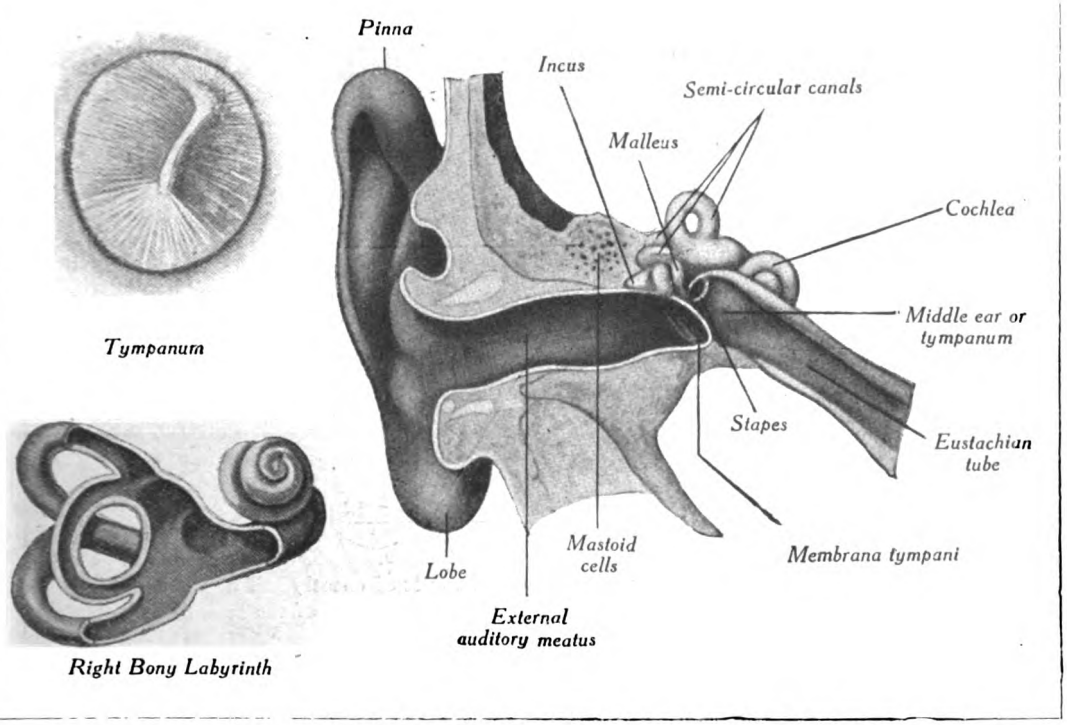
D	E	F	G	A	B	*c*	*d*
288	324	360	384	432	480	540	576

Of the notes in this scale it will be seen that only G, B and *d* are identical with the corresponding notes in the scale of C. At E we get a note 324, which is an interval $\frac{81}{80}$ above the E of the C scale. This interval is called a *Comma*, and is so small that the E of the C scale may be used in the D scale without disharmony. At A also we have a similar interval, and for the same reason the A of the C scale may be used for the D scale also. In practice, a compromise is arranged, called *temperament*, by which one note A fits into as many scales as possible without annoyance. But no such compromise is possible at F and C, where the interval is $\frac{135}{128}$ in each case, which is a very definite and perceptible interval. New notes have to be created, therefore,

between F and G, and between *c* and *d*; these are known as *sharps*. New sharps have to be introduced when A, E and B are made the keynote. This gives us in our scale five additional notes, which is the complete keyboard of a keyed instrument, the whole being repeated of course in each octave.

and B♭ can be made; but in keyed instruments, as we have seen, a compromise is made.

11. Interference.—When the air is subject to two trains of waves, it accommodates itself to both, and the result is a new train of waves whose



THE SOUNDS WE HEAR

are caused by waves which, collected in the Pinna, pass along the Meatus, and cause the drum (*membrana tympani*) to vibrate. This sets up corresponding vibrations in the bony labyrinth (*cochlea*) which contains the auditory nerve, the organ of hearing. Such, briefly, is the wonderful mechanism of the human ear.

Taking the scale of F = 341⅓, we should have:—

F	G	A	B	*c*	*d*	*e*	*f*
341⅓	384	426⅔	455⅑	512	568⅞	640	682⅔

Here the notes which vary from those in the C scale are B and *d*, and both are *flat*, or below the pitch required. In the case of *d* the new note required is only a comma below the C standard, but in the case of B the interval is $\frac{455\frac{1}{9}}{480}$ or $\frac{128}{135}$ below, and a new note, B♭, has to be employed for the purpose. Strictly speaking, this is not identical with A♯ which has a frequency $426\frac{2}{3} \times \frac{135}{128}$ = 450, in this octave; the interval between them is $\frac{455\frac{1}{9}}{450} = \frac{2,048}{2,025}$, which is rather smaller than a comma. On a violin the distinction between A♯

nature depends upon the amplitudes, wave-length and phases of the original waves.

In the simplest case let us consider the case of two sets of waves of equal amplitude and wave-length, which are also in the same phase. Under these circumstances, the air will be cut up into compressions and rarefactions in a similar manner and simultaneously by each set of waves. Compression will coincide with compression, and rarefaction with rarefaction. Every particle of air will have its displacement doubled, and the result will be, as shown in Fig. 19, a wave of the same wave-length with the amplitude doubled. If this state of things can be realised, the loudness of the sound will be increased, in fact, doubled. The same result will obviously follow if the second set of waves is a whole wave-length, or any integral number of whole wave-lengths, behind or ahead of the first.

Next consider the case of these waves when they

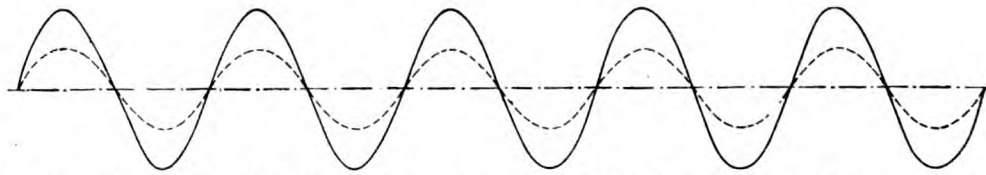


Fig. 19.—Air subject to two trains of waves accommodates itself to both. Two sets of waves of equal amplitude and length, also in the same phase, will, as shown above, produce a wave of the same wave-length with amplitude doubled.

differ in phase by exactly half a wave-length. The compression of one now corresponds point by point with the rarefaction of the other. A particle of air undergoing its maximum displacement towards the right under the influence of one set of waves, will be displaced an equal amount to the left under the influence of the other set. The result is a complete extinction of the waves, and with them of the sound. The same result would also obtain if the difference in phase were any *odd* number of half wave-lengths. If the amplitudes of the different waves were unequal, there would not be complete extinction but only a considerable reduction in the intensity of the sound (Fig. 21).

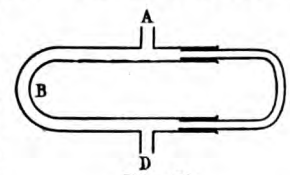


Fig. 20.

B—namely in about 1,100 feet. Now if the two trains are in the same phase at starting, it is clear that they cannot be so again until one second or 1,100 feet have been passed. One wave of B (l') falls $\frac{1}{200}$ of a wave-length of A behind a wave of A continuously. At a distance l from the start, a wave of B is $\frac{1}{200}l$ behind; at $2l$, a distance of $\frac{2}{200}l$; at $100l$, a distance of $\frac{100}{200}l = \frac{1}{2}l$ behind. At this point they are clearly in opposite phase, and there will be a reduction in the intensity. A little thought will show that at a distance of $200l$, the waves will be in the same phase again, and there will be reinforcement of sound. Thus, the result of the interference of A and B is, in every second, one

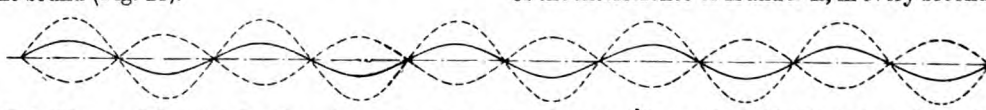


Fig. 21.—A difference in phase between two trains of waves of exactly half a wave-length results in a complete extinction of the waves and with them of the sound.

An apparatus for illustrating this is shown in Fig. 20. A B C D is a metal tube, arranged so that the portion C will slide in and out of B, as in a trombone. If a tuning-fork be sounded over A, the sound spreading down the tube will reach D, partly via B and partly via C. Starting with B and C of equal length, the sound of the fork can be heard normally at D. If C is gradually pulled out, a point is reached when the sound is practically unheard. The journey through C being now longer than that through B, the portion of the wave reaching D through C may become one-half wave-length behind that coming through B. Pulling C further out, we make the difference of path equal to a whole wave-length, when there is no extinction of the sound.

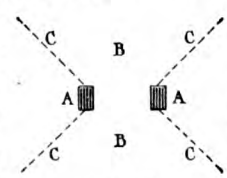


Fig. 22.

Now let us consider the case of two sets of waves, A and B, which differ in frequency and consequently in wave-length. For the sake of clearness, let their frequencies be 200 and 201 respectively, so that 200 waves of A are included in the same space as 201 of

reinforcement and one partial extinction of the sound. Thinking on the same lines, we can show that, if the frequencies were 200 and 202, there would be two such alternations per second, the number being always equal to the difference between the frequencies. When they are few in number they can be quite easily counted; beyond six they make themselves felt as an unpleasant jarring, until they reach about 24, when other considerations enter These ups and downs of sound are called *beats*, and their presence is responsible for musical discord.

To show the existence of beats, tune a violin string with a tuning-fork; then stick a small piece of sealing-wax on one prong of the fork, and sound the fork and the string together.

The interference of two sets of waves of different frequencies should be studied also graphically. Fig. 23 shows the displacement diagram of the wave resulting from the interference of two sets of waves whose frequencies are as 5 : 6, and whose amplitudes

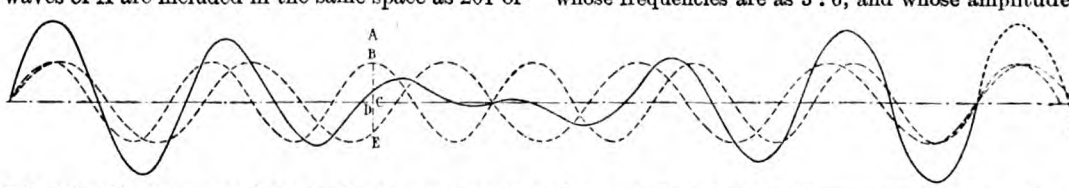


Fig. 23.—Displacement diagram of the wave resulting from the interference of two sets of waves whose frequencies are as 5 : 6.

are equal. First draw the diagrams of the two sets separately. Then draw the composite diagram by finding the resultant displacement at a sufficient number of points. Thus at A, the resultant displacement is B C—D E.

In all these cases we have assumed that the interfering waves are travelling in the same direction, so that the vibrations of the particles are kept in a straight line. When the waves interfere in other directions, the result is much too complicated to be discussed here. That it does take place may be shown by turning a vibrating tuning-fork through a circle near the ear. In the directions A A, B B, full sound is heard, but along the directions C C, there is reduction of sound. When the prongs move outward, a compression is formed towards A, but a rarefaction is formed between the prongs which travels outward towards B. Two sets of waves are thus formed which interfere along C C.

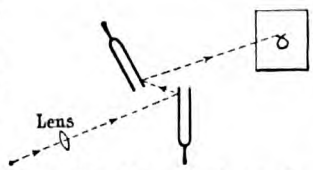


Fig. 24.—Lissajous' experiment.

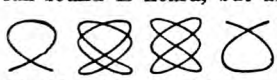


Fig. 25.—Lissajous' figures, obtained with frequencies in the ratio of 2 : 3.

12. Lissajous' Figures.—An idea of the nature of a composite vibration can be obtained graphically by using two tuning-forks according to the method of Lissajous. Each tuning-fork has a small plane mirror on one prong, and a small beam of light is reflected from one to the other, and thence on to a screen or into a telescope. The beam of light has the motion which is compounded of the two vibrations of the forks, which can be arranged in any position desired. Fig. 25 shows Lissajous' figures, obtained when the frequencies are in the ratio 2 : 3, the differences being due to the differences of phase at the instant when the composition begins.

The composition of vibration can be studied with the simple pendulum. While it is in vibration give it an impulse at right angles to the direction of motion. Notice the curve in which the pendulum moves, and how the curve changes. E. W. E.

ELECTRICITY AND MAGNETISM.—XIV

Strength of Current in a Circuit.—Is the current strength the same at all parts of the circuit? When the circuit is branched, is the current in any one branch equal in strength to that flowing along another branch? Is the voltage the same at all parts of the circuit, or does the E.M.F. change as the current passes from the positive plate of a generating apparatus to the negative plate?

Experiment 44.—*To find out if the current strength is the same at different parts of a circuit.*

Arrange an external circuit as illustrated in Fig. 50. To obtain a general result we need have only two branches, and these may be composed of a thin iron wire and a copper wire joined in parallel. Let these wires be each about four feet long. The circuit consists of a branched part and unbranched portions. Join two cells in series and connect one end of the external circuit to either terminal of the battery. (The term battery is used to denote any combination of two or more cells.) Leave the other end of the circuit free for momentary connection when a reading is about to be taken. Insert the galvanometer or ammeter at each of the points *a*, *b*, *c*, *d* in turn, being careful to see that the instrument is set accurately and the circuit properly completed. Loose connections must always be avoided. Where a wire has been severed, the ends must be reconnected by their being tightly twisted together.

Tabulate your readings thus:—

Point	Angle of Deflection	Tangent of the angle
a	0	.
b	0	.
c	0	.
d	0	.

The results for *a* and *d* should be the same, whereas those obtained for *b* and *c* in the branched portion will differ from each other and from those of *a* and *d*. But the tangent results of *b* and *c* added together equal that of *a* or of *d*.

It is evident that the current strength is the same at all parts of the unbranched circuit, and that the sum of the current flowing through the branches of the divided portion is equal to the current in the unbranched part. When the current arrives at *x*, the point where it reaches the branched portion of the circuit, it breaks up into two parts, one of which flows along the wire *x b y* and the other along *x c y*. At *y* these currents reunite. What proportion of the main current flows through any branch of a divided circuit depends upon the resist-

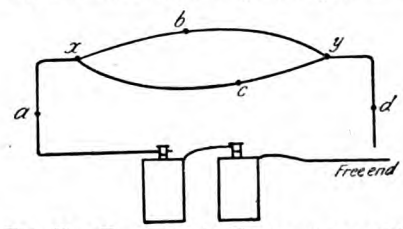


Fig. 50.—To ascertain if current strength is the same at different parts of a circuit.

ance of that branch. If there are two branches of equal resistance, though they may be of different materials, then half of the main current will flow along each branch. Should the branches be of unequal resistance, then that branch having the smaller resistance will conduct a correspondingly *larger* portion of the initial current.

Fall of E.M.F.—We are now quite familiar with the fact that a current of electricity can exist only as the result of a difference of potential.

The point we are considering now is the fall of E.M.F., or as it is sometimes expressed, the consumption of voltage in the circuit. The decline in E.M.F. along a circuit composed of parts varying in resistance is in many ways analogous to falling water that flows in a stream over ground having different gradients along the water course. The rate of fall of the water will be greater where the ground is steeper, and similarly the fall in E.M.F. will be greater in those parts of a circuit where the

resistance is relatively high. The different parts of a circuit that is not uniform in resistance use up the voltage in proportion to the relative resistances of the parts.

Experiment 45.—*To note the fall in E.M.F. along a uniform conductor.*

Obtain about forty inches of wire composed of a substance known as German silver. This can be obtained from an electrician's at quite reasonable price per dozen yards. The wire should be of medium gauge and not covered with any insulating material. Half a dozen terminals or binding screws would be useful, though little brass nails might serve instead.

In a piece of wood about forty-two inches long by three inches wide insert two binding screws (or nails) A and B at a distance of 39¼ in. apart. Connect these two screws by a piece of the uniform German silver wire stretched tightly in a straight line. This wire should be exactly one metre in length, not including the screws *under* which the wire is fastened to the board. The holes in the terminals are for connection wires. Now arrange a main circuit consisting of two cells in series and thick copper connections. (See Fig. 51.) Leave the end of the connecting wire at A free; otherwise there will be a loss of current. The connection at B should be fixed. Next arrange a shunt consisting of a single cell, a tangent galvanometer accurately set, and connecting wires. The end of the shunt wire at A should be fixed to the terminal, but the other end of the shunt must be left free in order that it may be pressed upon various parts of the uniform wire $A\ B$. *Be very careful to see that the cell in the shunt is fixed so that it will send a current towards A, just as the two cells of the main circuit also send a current towards A.* We are now ready to perform the experiment.

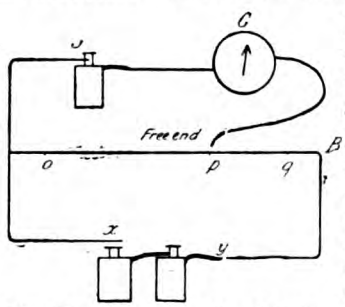


Fig. 51.—To note the fall in E.M.F. along a uniform conductor.

With the left hand press the free wire of the main circuit firmly against the screw at A and at the same time with the right hand press the free end of the shunt on the uniform wire $A\ B$ at a point o near A. Note the *direction* in which the needle of the galvanometer moves. Release the wires and allow the galvanometer to become steady. Now again make contact of the main circuit at A, and bring the free end of the shunt in connection with $A\ B$, at a point q, near B. Observe the direction of the moving galvanometer needle. Does it move in the same direction as it did when you made contact at o?

In a similar manner make connection of the free shunt wire with $A\ B$ at different points between o and q. With care, you may find a point p such that the galvanometer needle does not move either way.

What is the explanation of the experiment?

The two cells being joined in series at $x\ y$ have an E.M.F. of four volts, assuming that each cell has two volts. The cell at s has two volts. When the connections are made at A and the point o there is at A an E.M.F. of four volts attempting to send a current along the main wire $A\ B$ and also around the shunt in the direction $A\ s\ o$. The cell s, however, has a two-volt E.M.F. trying to send a circuit in the opposite direction towards A, and this cell in the shunt is also helped by a voltage at o. The E.M.F. at this point will have fallen a little. It may be three volts for instance. The three volts at o and the two volts of the cell in the shunt added together come to a higher voltage than that of the main circuit at A. Hence a current flows in the shunt in the direction $o\ s\ A$. Now consider what happens when the free end of the shunt is connected with the German silver wire at q. The voltage at q is less than that at o because of the resistance of the greater length of wire opposed to the original four-volt E.M.F. of the main battery at $x\ y$. Suppose the E.M.F. to have fallen so that it is one volt at q. This time we have only one volt pressure in the main circuit to add to the two volts of the cell s in urging a current in the direction $o\ s\ A$. The voltage at A is about four volts as before, so that it is a case of four against three, hence a current now flows along the shunt in the direction $A\ s\ o$. Consequently the needle of the galvanometer moves in the opposite direction. *The fall in E.M.F. along the wire A B accounts for the alteration in the direction of the galvanometer movements.* When the free end of the shunt wire makes connection with the wire $A\ B$ at p, when no movement of the needle takes place either way, then there is no current flowing along the shunt because the potential at A is the same as that of the cell s added to that of the main circuit at p.

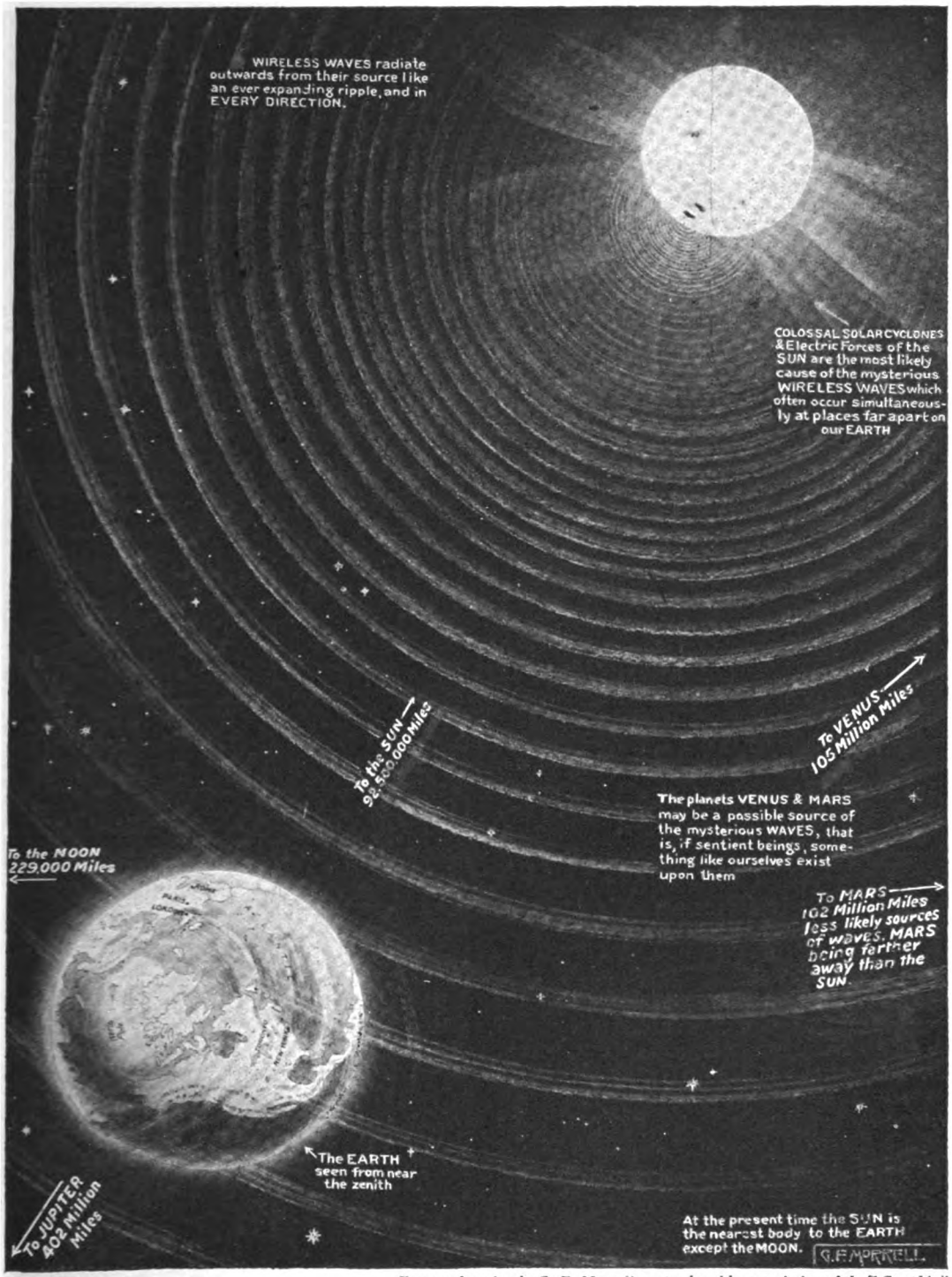
The result of the experiment shows that there is a steady fall in E.M.F. along a uniform wire. When the wire is not uniform the fall is not steady. The connecting wire of the arrangement being composed of thick copper, we have neglected their resistance which only slightly modifies the E.M.F.

The Potentiometer.—There is a very important fact which needs further consideration in connection with this experiment.

It is obvious that the higher the voltage of the cell at s in the shunt, the less help will it need from the main circuit to balance the voltage at A. Hence the higher the E.M.F. of the cell at s the further along the main wire from A need the point of contact be made so that there is no deflection of the galvanometer. *The length along the wire A B measured from A to the point p such that there is no galvanometer movement, is proportional to the voltage of the cell in the shunt.* This fact supplies us with a method of measuring voltage of various cells without a voltmeter, provided we have a standard cell of known voltage at our disposal. When the uniform wire $A\ B$ is used for this purpose it is known as a *Potentiometer.*

Experiment 46.—*To find the voltage of a cell by means of a standard cell and a potentiometer.*

Arrange the apparatus in the same manner as in the last experiment. First use the standard cell at s in the shunt. Suppose its E.M.F. is 1·8 volts. Adjust the free end of the shunt until a



From a drawing by G. F. Morrell: reproduced by permission of the "Graphic."

IS THE EARTH IN WIRELESS COMMUNICATION WITH MARS?

The mysterious signals which from time to time are received simultaneously at distant wireless stations have led many people to answer the above question in the affirmative. It is far more likely that the waves responsible for these messages owe their origin to the enormous electro-magnetic energy in the sun.

point p is found when *the galvanometer does not indicate a current.* Measure the length $A\ p$ in some convenient unit, centimetres preferably. Suppose $A\ p$ to be forty centimetres. Now remove the standard cell and insert the cell whose E.M.F. is to be tested. Again adjust the free end of the shunt until there is no movement of the galvanometer. Let the point of contact be p and suppose that the distance $A\ p$ is thirty centimetres. Then if forty cms. represent an E.M.F. of 1·8 volts, what E.M.F. will thirty cms. represent? The lengths of these distances are proportional to the E.M.F.s of the respective cells, so that the voltage of the cell is $\frac{30}{40}$ or $\frac{3}{4}$ that of the standard cell. Therefore the voltage of the tested cell is $\frac{3}{4}$ of 1·8 = 1·35 volts. L.M.P.

ZOOLOGY.—XXII

THE order *Teleostei* or Bony Fishes is the largest and in many respects the most interesting of the divisions by which fish life is classified. In it are to be found the Salmon and the Carp, the Eel, the Pike, the gaily-coloured Flying Fish, the useful Flounder and other well-known fishes.

In this order the form of the individual varies very greatly; sometimes the skin is covered with projecting spines and sometimes it forms a bony shield. The jaws again are not by any means constant in the different species, since in some cases they are formed into massive teeth, whilst in others the contrary is the case. Throughout the order, however, the skeleton is more or less bony, and generally speaking the body is covered with overlapping scales.

Salmon

Perhaps the best-known family included in the *Teleostei*, almost certainly the family that has afforded the most recreation to the angler, is the *Salmonidæ*, so called, it is said, from the verb *salire* to leap. Of this family there are some fifteen or more genera in each of which the maxillary bones form the sides of the jaw, and the air-bladder is large and simple. It is curious that Fresh Water Salmon are brown, and Marine Salmon almost silvery, the change occurring in the same individual at different times.

The young Salmon or Parr make their first trip to the sea from the rivers in which they are born at the age of about fifteen months. Here they remain, it is commonly supposed, for a year or so, when they again ascend to fresh water. At this stage in their career they are known as "Grilse," the term Salmon being applied to the fish only on its second and subsequent ascents to fresh water. At different times various theories have been advanced to account for the migration which the salmon annually undertakes from salt water to fresh. For long it was held that the governing instinct was solely that concerned with the depositing of the spawn.

There are, however, many important objections to this theory. Sir Herbert Maxwell makes the interesting suggestion—"Salt water is not the native atmosphere of Salmon; they endure it for awhile without inconvenience, but the time may arrive when they can endure it no longer, and they may then dare every difficulty to reach the refreshing currents of their native stream. This can never be more than an hypothesis, and as such is worth but little; nevertheless, it is a question not to be dismissed as trivial, whether vertebrate animals born and reared in fresh water can inhale and swallow a strong solution of salt without experiencing some of the symptoms which are familiar to ourselves."

Sea Trout

A controversy as inconclusive as that which has raged around the Salmon's annual migrations has long distinguished the question whether the Salmon feeds during his fresh water periods. On the one hand the fish is known to take the angler's fly, on the other his stomach at such times exhibits no traces of food. The pink colour of the flesh is attributed to the diet of crustaceans which the Salmon takes when in the sea.

The British Salmon is confined to the northern hemisphere, but occurs in America and Asia as well as Europe. In Britain this fish is found in certain streams usually from October to January. The Sea Trout or Salmon Trout is a coarser fish than the true Salmon, and its scales are smaller.

The Rainbow Trout has been introduced into Britain from the Rocky Mountains, where it is seen at its best. The Brook Trout is a purely fresh water fish which affords excellent sport for the angler.

The family *Clupeidæ* is of considerable value to the human race, since many of its members are of the utmost importance as food. They are distributed in all seas.

The Herring, one of the best-known members of the family, swarms in immense numbers in the North Atlantic and even along the northern coast of Asia. Though these fish inhabit the deep sea, they come close to shore at certain periods for the purpose of spawning. Nothing certain is known as to the causes which operate to bring the Herring into certain parts of the ocean or which cause its prolonged absence

from districts which it once frequented. Within certain areas, however, its visits are constant and support a large and profitable industry. The British Herring catch amounts to about 8,000,000 hundredweight.

The Sprat is a small fish, abundant off the Atlantic coast of Europe and in the Western half of the Mediterranean, which until recently was sold as Sardines.

The Pilchard is frequent in the Mediterranean and adjacent parts of the Atlantic, and is taken in large numbers off the coast of Cornwall. Dr. Günther divides the Pilchard into the Sardine of the Mediterranean and the Pilchard of Cornwall.

The Anchovy is extremely plentiful in the Mediterranean and off the coasts of Holland.

The Tarpon is a native of the warmer American seas, caught principally off the coast of Florida. It does not, however, limit itself to the sea, and frequently enters rivers and inland lakes. This fish has been aptly described as a "big herring." None the less it is, it must be admitted, a herring so exceedingly enlarged that the comparison without other particulars would be entirely misleading. It is carnivorous in its habits, and attains a length exceeding seven feet. A fish possessed of great strength and considerable resolution, the Tarpon is dear to

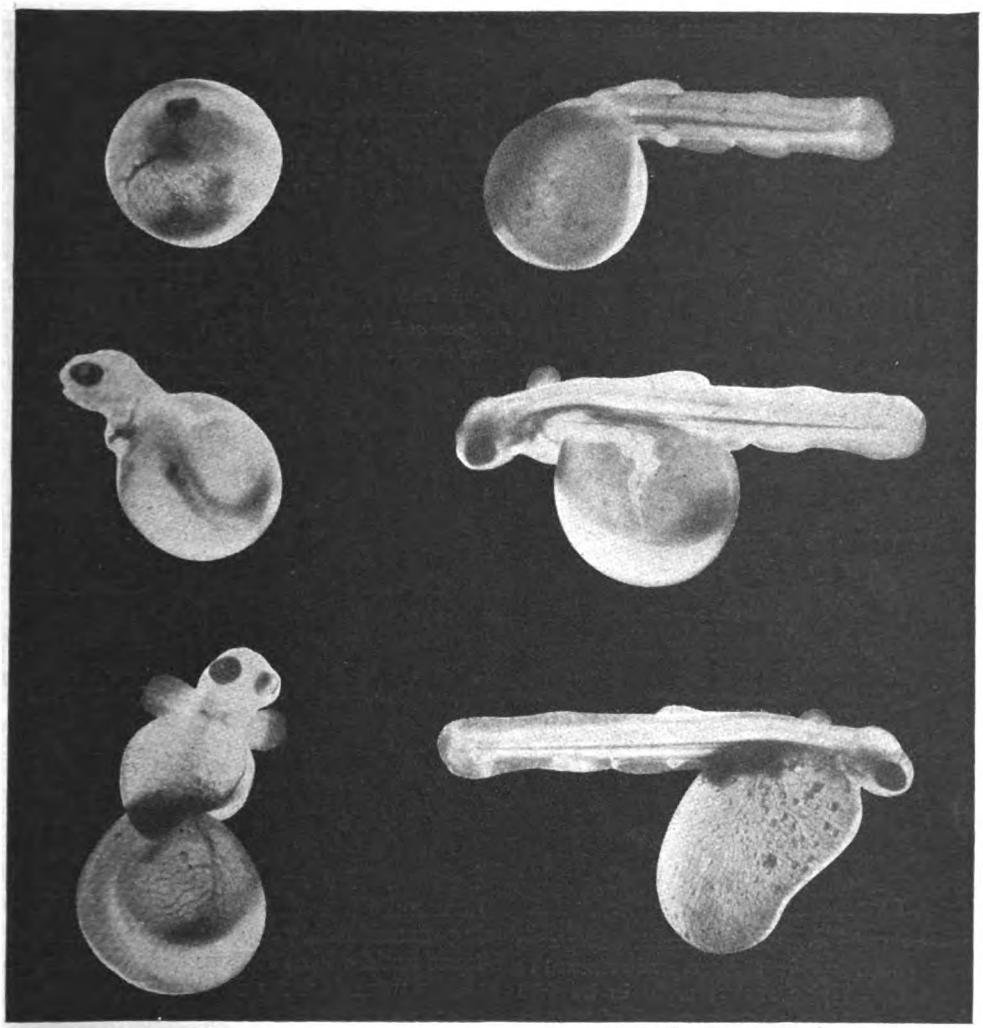


Photo: Dr. Francis Ward, F.Z.S., F.R.P.S.

SIX STAGES IN THE HATCHING OF A SALMON.

The length of time before the eggs hatch depends on the temperature of the water. Normally the ova lie about for three months in the gravel, eddies among the stones carrying oxygen to the developing embryo.

the heart of the sportsman who plays it with rod and line in a fashion that provides unlimited excitement and demands prodigious skill.

The family *Siluridæ*, or the Cat Fishes, include many members frequenting the fresh waters of temperate and tropical regions. In appearance some differences are to be detected between the various species, but all are alike in their carnivorous habits. The sea species which are less numerous than the fresh water varieties haunt the shallow waters close in shore where they feed on the sea bottom.

Photo: Mr. Francis Ward.

LIFE OF A SALMON AS READ BY THE SCALE.

This Salmon spent two years in fresh water as a Parr, then two years in the sea, and returned to fresh water, probably to spawn, early in its fifth year. The scale as seen above is magnified twenty-five times.

The division of the *Siluridæ* into numerous sub-families is based largely upon anatomical details which in one or two instances form very interesting features of this curious fish.

In the case of the *Clarias*, for instance, a fish common to the marshy waters of Africa and South Asia, an accessory respiratory organ, situated above the gills, permits its owner to live to some extent independently of water. This fish, consequently, in days of drought is able to heave himself up upon his fins, and to stump across country. Since the river has ceased to come to the Clarias, the Clarias perforce goes to the river.

In size the Cat Fish show considerable variation. The *Silurus glanis*, which is the solitary European representative of the family, is a huge fish of which a specimen was once taken in the river Bug, sixteen feet in length. The customary length of the *Silurus glanis* is, however, about ten feet, and it is fairly common in the larger rivers of the Continent east of the Rhine. The necessity for the generic name is well instanced by the Wolf Fish, of a different family, which is called the "Cat Fish" quite as frequently as by its right name.

Cyprinidæ

More than one hundred genera of fresh water fishes are included in the family *Cyprinidæ*, of which the most popular member is possibly the Carp.

The Common Carp, the proud monarch of hundreds of ornamental lakes and a familiar figure in many rivers, is a native of China, whence it was introduced into Britain at a date of which uncertainty is the only certain element. In appearance the carp is a handsome fellow, its size and weight varying considerably according to the conditions amid which it lives. A carp exceeding thirty pounds is no doubt above the British average.

Attention should be drawn to the fact that the excretal discharges of the carp tend to render permanently turbid waters which the *Salmonidæ* and other valuable fish would leave unpolluted. This fact, were it more generally appreciated, would probably cause this fish to lose much of the popularity it now enjoys.

The Gold Fish is a Carp-like fish first produced as the result of artificial selection in China and Japan. In Britain it is most frequently seen in ornamental lakes and in small aquaria. It can scarcely be too strongly urged that the scandalous habit of

cooping these fish in small globes is a piece of abominable cruelty. In a state of nature the Gold Fish requires a fair-sized pool, or a small river, provided with an ample supply of sheltering water weed and a great abundance of larvæ.

Barbel and Bream

The Barbel, found in many English rivers where it usually attains a weight of about ten pounds, and common to many rivers in Central Europe, is one of some two hundred species of the genus *Barbus*. It feeds upon worms and other food which it finds in the river bottoms. The Gudgeon is found in England in most rivers which are both clear and slow running. Though a smaller fish than the Barbel it is similar in some respects but carries only two barbels instead of four.

The Bream is a species confined to Europe north of the Alps. In England the average weight of this fish is between two and four pounds, though much larger specimens have been caught. It is a somewhat shy fish, tenacious of life, valued as food more greatly on the Continent than in England. The White Bream or Bream-Flat, far more common on the Continent than in England, rarely exceeds one pound in weight.

The Roach is common to Europe north of the Alps. It is a somewhat small fish, rarely exceeding two pounds in weight. The Tench is found throughout Europe, generally in muddy water. In England it rarely exceeds four pounds in weight, though exceptional specimens have been taken.

Roach and Chub

The Chub, like the Roach, is of the species *Lenciscus* of which other well-known species are the Rudd or Red-Eye, the Minnow and the Dace. The *Lenciscina* includes many species all known as "White-fish" which are common to the temperate parts of Europe, Asia and North America. The Bleak is also allied to the Roach.

The Electric Eel though no relation to the true Eel is not unlike it in appearance. It is a member of the family *Gymnotidæ*, but is peculiar in that unlike the other members of this family it is entirely devoid of scales.

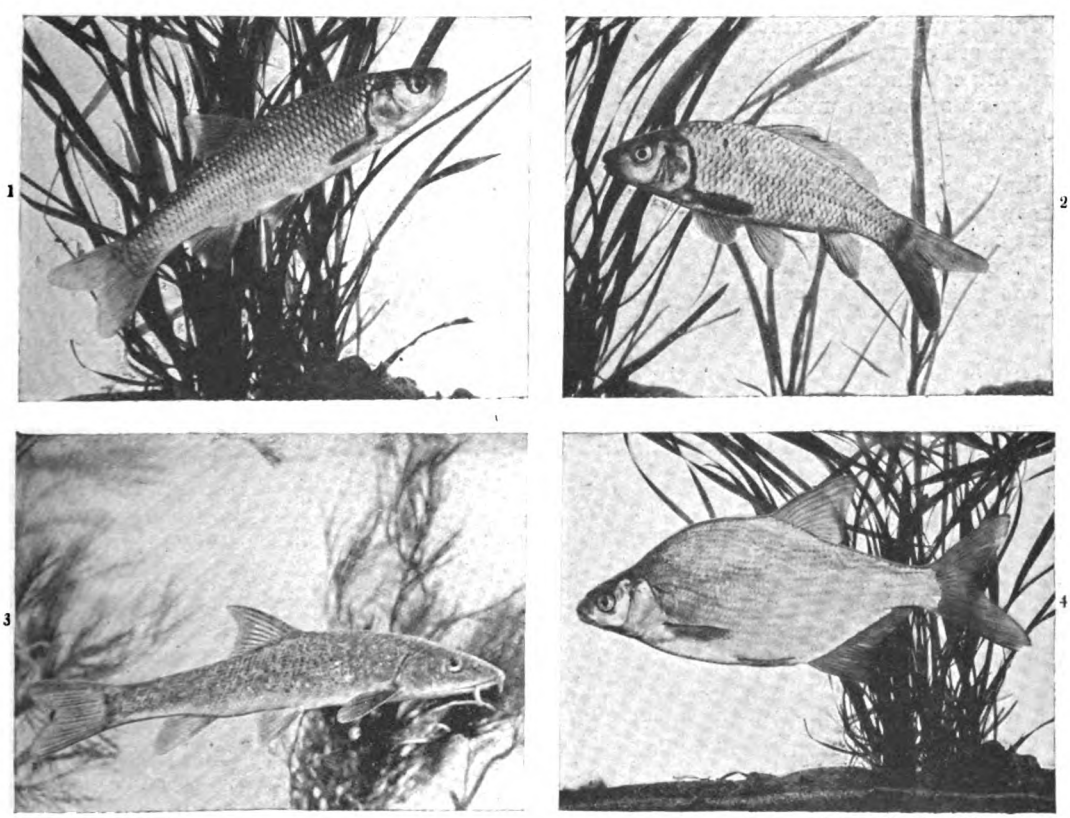


Photo: S. C. Johnson, M.A.

FOUR COMMON FISHES.

1. Chub; 2. Carp; 3. Barbel; 4. Bream.

On the other hand, this eel possesses in his electric organs a weapon which is absent in his relatives. The electric shock, which is extremely powerful, is produced by modified muscular tissue which forms nearly one-third of the weight of the fish. After delivering three or four shocks the Electric Eel is temporarily exhausted. The Electric Eel is met with in the fresh waters of Central and South America.

The sub-order *Apodes*, which embraces the Eels, includes a family, the *Auguillidæ*, in which we find a fish so little distinguished by Nature as to cause us usually to speak of it with contempt, but which nevertheless has a story which is an amazing blend of mystery and romance. The fish in question is the Common or Fresh-water Eel.

For hundreds of years this curious creature has frequented rivers and ponds in the very heart of our country but, though its habits were the subject of endless inquiry, until some twenty years ago there was no one who could say where it came from or where eventually it disappeared to.

Fresh-water Eels

Endless were the speculations of thinkers' utterly grotesque as often as not were the resulting conclusions. Within recent years, however, scientific research has to some extent dissolved the mystery though it has not lessened the romance.

The Fresh-Water Eel, it is agreed, is born somewhere in the deep Atlantic off the West coasts of Ireland and France. In this undiscovered nursery the "Leptocephali," as the flat and transparent youngsters are termed, gradually change their form into the almost cylindrical shape of the Elver. This change is marked by a more or less simultaneous movement eastward which is steadily pursued until the Elvers in their millions are pouring up the western rivers of Ireland, England and France.

At this stage the mass disintegrates ; some push on up the main stream, others branch off down tributaries and canals, others scale the banks. In this fashion, up stream, down ditches, across country, the Elver makes it way until with the finding of a satisfactory resting place, possibly the pond of some wayside farm, it brings its journey to an end. How long it remains in this fresh-water haunt no one can say definitely, but when it has attained a length of three feet or so, sooner or later, unless forcibly prevented, the Eel climbs from its pond, makes its way through ditch, brook and river to the sea and thence back to its birth place in the ocean where it spawns and, so it is held, soon dies.

It is now generally accepted that the Eel cannot spawn except in salt water, and it is doubtless the generative impulse that drives the Eel after a prosperous and peaceful existence inland to undertake the long and hazardous journey back to the depths of the ocean.

Conger Eels

The Fresh-water Eel, it may be noted, is enabled to make his way overland by the presence adjacent to the gills of large cavities which so long as they remain filled with water save him from suffocation. This explains how Fresh-water Eels can remain alive for a comparatively long time after they have been caught.

The Conger is wholly a marine fish, and is found off the coasts where the water is deep and the bottom rocky. His body is destitute of the extremely small and transparent scales borne by his relation the Fresh-water Eel. The female of this species is considerably larger than the male, which rarely exceeds two feet in length.

The Conger Eel has larger eyes and jaws than its fresh-water relative, and can therefore be easily distinguished.

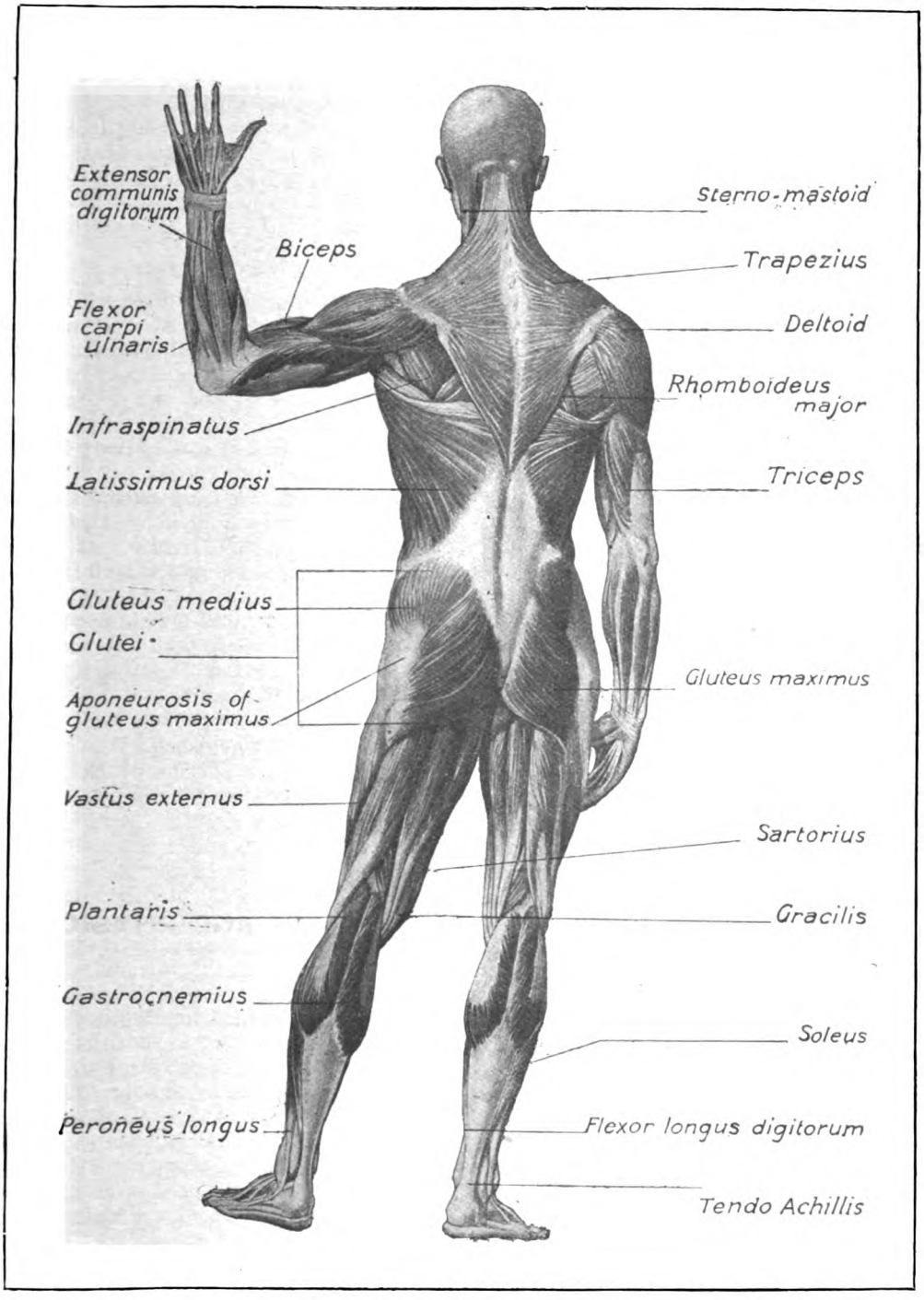
The number of species of Eel is large: altogether there are perhaps about one hundred and fifty. A. B.

ANATOMY AND PHYSIOLOGY. IV

In the last lesson a man's body was considered as a machine for doing work. This work is done by means of muscles, which move bony levers, with the help of joints, under the direction of nerves. The muscles burn up carbon, as coal is burnt in a furnace. Food and air are required for this, and also means of getting rid of the waste and of the incombustible residue. Means are also required to prevent the body getting too hot or too cold.

We shall now see what the organs are which do these different things; but first a few words are needed as to the cells of which they are made.

As was seen in the first lesson, all parts of the body are made up of *cells*, little masses of protoplasm each containing a nucleus. In the human body, and in all the higher animals, each cell does one thing, and one thing only. Each has, so to speak,



MUSCLES OF THE HUMAN BODY.

Muscles are of two kinds—"striped" or "voluntary" and "unstriped" or "involuntary." The former, which occur in the limbs, one can control at will; that is to say, they contract under impulses conveyed by nerves. The latter, which occur in the internal organs, cannot be so controlled.

its own trade, and it does nothing but its own trade, and never does that of any other kind of cell.

Some cells do active work, and others are only passive and are used as tools by the active cells.

The active cells are those of muscles, nerves and glands.

The passive cells are called "connective-tissue" cells, and make up bone and gristle and fat.

In order to study cells we have to use the microscope, because the cells are too small to be seen with the naked eye. This is always considered as part of physiology, because it is carrying anatomy farther than can be done by dissection. The technical name for the study of cells is "histology," which means the study of a web or tissue. It is also sometimes called "minute anatomy," because it is the study of structure carried on to the farthest possible limits.

The Active Cells

Histology is studied either by taking a small scrap of tissue and pulling it to pieces with needles on a glass plate, and then looking at it under the microscope, or else by means of "sections." In preparing sections the material is hardened, by freezing or some other method, and fine shavings are cut off it with a razor. These shavings, or "sections," are stained with various dyes which help one to see particular parts more clearly. They are made into transparent slides, mounted on glass and examined under the microscope.

We have seen that muscle will "contract" and relax again. A scrap of muscle from an arm or a leg looked at under the microscope is seen to be made up of a bundle of "fibres" all lying in the same direction, like a bundle of stair-rods tied together. Each rod is crossed with alternate light and dark bars, and is called "striped muscle." When the muscle contracts, part of the light part disappears into the dark part, and the whole muscle grows shorter and broader. This striped muscle is what is found in the limbs and body—in all the muscles which one can move at will; it is sometimes called "voluntary" muscle.

There is another kind of muscle, called "smooth" or "unstriped" or "involuntary" muscle, which also will contract, but which cannot be controlled by the will. It occurs in the internal organs, particularly the intestines. It consists of long, thin, pointed cells, each containing a nucleus, and marked by lines which run the length of the cell, not across it, as in voluntary muscle.

The voluntary muscles contract under impulses conveyed by *nerves*. Nerves are cells which consist, like all cells, of nucleated masses of protoplasm, and they are distinguished by the great length of their fibres. Each nerve cell consists of a central mass, containing the nucleus, and from this central mass grow out "processes" or fibres. One fibre is very long and is called the "axis cylinder process," and there are also a number of short processes which communicate with neighbouring nerves.

The function of nerves is to act as it were as telephone wires, and carry "impulses." When your skin is touched, or cut or burnt, the pain you feel is carried to your brain along nerves; and when you move your hand to avoid the pain or for any other reason, the impulse is carried down the nerves to the muscles.

Nerves, then, are means of communication between the outside world and the brain, and between the brain and the muscles.

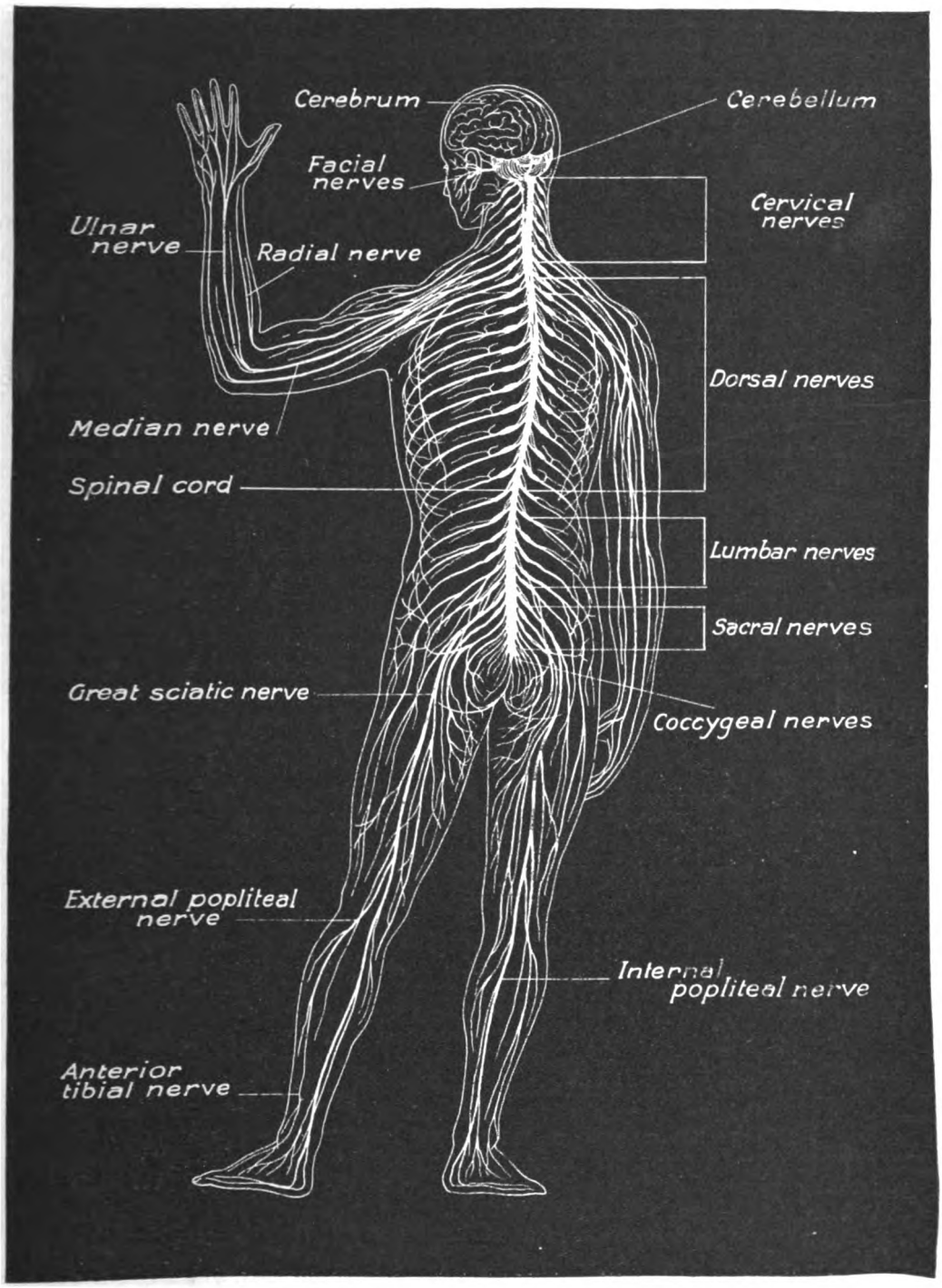
In the last lesson (pp. 20-23) we spoke of the digestion of food. In digestion the valuable parts of the food are dissolved out. This is a chemical process, and the chemicals required for it are supplied by *glands*.

The Passive Cells

A gland in its simplest form is a tube closed at one end, and open at the other, lined by a single layer of gland cells. Outside the tube is a network of blood vessels. The gland cells have the power of selecting from the blood the substances they require, and filling the tube with them, sometimes changing them in the process. The tube opens on some surface which communicates in some way with the outside of the body. Thus, the sweat glands open directly on to the skin, the mucous glands in the lungs communicate with the outside through the mouth.

The glands in the intestine lead outside by the back passage, and the kidneys lead outside by way of the front passage. The essential thing about a gland is its power of taking something out of the blood, and passing it on somewhere where it is wanted, or where it can be got rid of by the body. This function is called "secretion." The cells covering the skin and lining glands and all surfaces communicating with the outside are called "epithelium" or epithelial cells.

The chief function of the connective tissues is that they are used by the active tissues. There is connective tissue between the cells of the muscles and organs, and the connective



SPINAL CORD AND SPINAL NERVES.

Nerves are cells consisting of nucleated masses of protoplasm and are distinguished by the great length of their fibres.

tissue keeps them in place together, and forms coverings for them. The simplest kind of connective tissue is made up of cells which are a good deal branched, and which lie in a mass of jelly which is called a "matrix." This is the tissue which lies between the active cells, and fills up crevices between muscles and organs. Fat is connective tissue the cells of which are swollen with drops of grease.

Sometimes this matrix contains tough white fibres which make coverings for organs, called "capsules," or bands which join bones together, called "ligaments," or join muscles on to bones, forming "tendons." This is "white fibrous connective tissue." Sometimes the matrix contains elastic fibres which will stretch and recover; this is "elastic tissue." Sometimes it contains a substance called "chondrin," and then forms "cartilage."

Cartilage is a smooth substance which covers the ends of bones and adjusts them to one another's shape, so as to form smooth-working joints. Some joints contain separate plates of cartilage which fill up gaps between the bones.

Bone Formation

Lastly, bone is a form of connective tissue. When the limbs of a child are first formed, before birth, they are made of rods of cartilage. As time goes on, these rods change their character and become bone. They are gradually replaced by a connective tissue which contains lime.

It should not be imagined, however, that the cartilage is filled with lime; it is changed into another substance, bone, which has the shape of the cartilage, but is of quite different structure, and contains lime and forms the hard rods, plates and masses which make up the skeleton. The ends of bones are made up of spongy masses, with a hard covering, and contain red marrow, which consists of cells; this spongy material is called "cancellous" bone. The shafts are hard tubes of bone, with marrow in the middle, and are called "compact" bone.

If you take a piece of skin or a piece of muscle, you find it consists of cells of different kinds, and you say that it forms such and such a "tissue." When a mass of tissue can be removed complete, and has a covering of its own, and when this mass has a special function of its own, like the heart or the liver or the kidney, it is called an "*organ*."

How are these various cells and tissues arranged?

The human body is a long structure, consisting of head, trunk, and two pairs of limbs. If you examine a spine, or backbone, you find it is made up of a string of bones, the vertebræ, which differ in size but are all of the same general pattern. They each have a "body," which is an oval plate of bone varying from about half an inch to an inch and a half in thickness, and from the back of the body an arch of bone projects. As the arch of each vertebra is placed over its neighbour, all the arches together make up a tunnel, which is called the "spinal canal."

It is easy to see that the spine is made up of a series of divisions, or "segments," and the whole body is really made up on the same plan. When the body is being formed, before birth, the whole of it is developed in a series of segments, one behind the other, and the segments of the spine can be seen throughout life.

The Brain

Perhaps the most interesting part of the body is the brain. It is the "seat of consciousness." Without a brain we can feel nothing, see nothing, hear nothing. All our pleasure and all our pain in life depend on our brains being in good working order and in communication with all parts of the body by means of nerves.

We will, therefore, begin our survey of the structure of the body with the brain. It consists of a mass of nerve cells, and different parts of it have control of different functions. Part of it has to do with sight; the nerves from the eyes are connected with this part, and if it is destroyed sight is destroyed also, even though the eyes themselves and their nerves may be uninjured. Other parts have to do with hearing, smell, speech, and movements of the body and limbs. Nerve fibres connect all these different centres together.

We have mentioned before the power the body has of adapting itself to its surroundings. If you hear a motor coming along the road, you move your limbs so as to get out of the way. If you see a ripe apple on a tree, you move your hands to pick it. If you smell a bad smell, you turn your head away quickly.

It should be noted that all these movements, made on account of special sensations, depend on nerve fibres running through the brain which connect the centres for hearing and sight and smell with the centres for movement of the head and trunk and limbs.

The brain, then, is a great collection of nerve cells which form an oval mass about

6 inches long, 5 inches wide, and 4 inches thick. It is a soft thing and easily damaged, and to protect it from injury it lies inside a bony box, called the skull, which fits it exactly.

The brain and skull are placed at the upper end of the trunk, and the brain is connected by means of nerves with every part of the body.

The nerves for the parts nearest the skull, for the eyes and face and ears and mouth, come straight from the brain through holes on the under side, or "base," of the skull. The nerve fibres for the trunk and limbs come from the brain in one large tail through one large hole in the back part of the base of the skull and run along the trunk—this is called the spinal cord.

If this cord is snapped just outside the skull, which happens when a man breaks his neck, instant death is the result. The whole body is then cut off from the brain, and no movements can be made, no breathing can be done, and no sensations can be felt.

The spinal cord, then, has to be protected just as much as the brain. For this purpose it lies in the tunnel made by the arches of the vertebræ, and is thus protected from injury. The vertebræ are jointed together so that the spine can be bent and the trunk moved without interfering with the protection of the spinal cord from injury.

Between each of the vertebræ there is a gap on each side close to the point where the "arch" joins the "body" of the vertebra. Through this passage a nerve passes from the spinal cord to the body on each side. There are thus a pair of nerves for each "segment" of the body.

The Nervous System

Each of these nerves—those on the right and left sides of the body—is made up of fibres which are coming from the skin to the brain, carrying sensations, and other fibres going from the brain to the muscles. These are called respectively "sensory" and "motor" fibres.

The brain, spinal cord, and nerves make up the *nervous system;* the brain is the oval mass described above, the spinal cord is a long continuation of the brain substance, and from it, on each side, a series of pairs of nerves come off and pass outwards, one pair between each two vertebræ. These nerves pass out as cords which divide up into branches and are distributed all through the muscles and to the skin.

The skull, which contains the brain, is an oval case, with holes on its under side through which the nerves and spinal cord pass out. The skull is deeper behind than in front, and its under surface is sloped. Under the forepart are the bones of the face which are so shaped that they form sockets for the eyes, the passage of the nose, and the roof of the mouth.

The mouth is completed by a separate bone, the lower jaw, which is fixed to the base of the skull by a joint. The skull and lower jaw make up the skeleton of the head. Below the lower jaw is a single small bone called the hyoid, which is not directly jointed on to other bones. It is U shaped, and muscles run between it and adjacent parts.

The skull is supported on the spine, and the large hole, called the *foramen magnum,* through which the spinal cord passes, is immediately over the tunnel formed by the arches of the vertebræ.

The vertebræ are twenty-four in number. The upper seven form the neck, and are called the *cervical* vertebræ (cervix means neck); the next twelve have ribs attached to them, and are called *dorsal* vertebræ (dorsum means back); and the last five form the loin, and these are called *lumbar* vertebræ.

Ribs and Chest

Below the spinal column, and continuous with it, is a triangular piece of bone, really made up of five vertebræ all joined together in one mass, through which the spinal canal is continued, and along which the nerves from the spinal cord run. This mass is called the *sacrum.*

At the lower end of the sacrum are three more small vertebræ, which form the trace of a tail. They are called the *coccyx.*

From each side of the dorsal vertebræ spring the ribs. These are long, thin, flat bones which are curved forward and are joined on to a flat bone in front, the breast-bone or sternum, and so enclose a space, the chest.

They do not join directly on to the breast-bone, but each is joined on to a piece of cartilage, which in its turn is joined on to the breast-bone and forms a link between the two. The bottom two ribs are called "floating" ribs, but these do not join the sternum.

The upper ribs lie in a plane which is nearly at right angles to the spine, so that when one is standing upright they are nearly horizontal; the lower ribs at first slope downwards from the spine, and then turn upwards again towards the sternum or breast-bone.

D. W. C.-J.

Continued from page 34.

LANGUAGES:

Contributors:—LATIN, GREEK and FRENCH (E. A. Baker, M.A., D.Lit.). GERMAN (M. A. Lewenz, M.A. [Lond.]). SPANISH, RUSSIAN and ITALIAN (Alfred Calvert, First Prizeman in Modern Languages, R.S.A., London).

LATIN.—XXVI

THE primary function of the genitive case is to show relations between substantives. The commonest attribute of a substantive is an adjective. Apart from adjectives, substantives are most frequently qualified by a substantive in the genitive case. All kinds of connexions are indicated by the genitive, but these can usually be expressed in English by the preposition *of*. The genitive is also used as a complement to verbs and adjectives.

The Genitive Case

The genitive may be used attributively, predicatively, or objectively. The student will find it makes for clearness to keep these uses distinct in his mind, and we will accordingly group the various kinds of genitive together under these three heads.

Before proceeding to classify let us, however, glance at an important distinction, that between the subjective and the objective genitive, which may in doubtful cases be overlooked and cause confusion. In the subjective genitive the substantive in the genitive case represents the subject of a verb implied in the substantive on which it depends; in the objective genitive the substantive in the genitive case represents the object of a verb so implied. Thus in :— **odium populi Romani**, *the hatred of the Roman people* (i.e., *the hatred felt by the Roman people*), the verb **ōdĭt**, *hates*, is implied and the subject of this would be **populus Romanus**. But in **odium nostri hostis**, *hatred of our enemy* (i.e., *the hatred we bear towards our enemy*), the implied statement would read: **odimus nostrum hostem**, *we hate our enemy*, **nostrum hostem** being the object of the verb **ōdĭmŭs**. The same distinction must be drawn when the substantive in the genitive case is superseded by an adjective. Thus we may have **fratris invidia** or **fraterna invidia**, *ill-will against a brother;* **patris iniuria** or **paterna iniuria**, *a father's injustice;* the relation being an objective one in the two first phrases and subjective in the second two.

Let us now proceed to enumerate the more important uses of the genitive under the three main heads differentiated above.

The Attributive Uses of the Genitive

(1) One of the commonest kinds of connexion expressed by the genitive both in Latin and English is that of possession, origin, or authorship, as in :—

Amici **Ciceronis** apud eum erant.
Cicero's friends were at his house.
Thesauri **Arabum**.
The treasures of the Arabs.
Cuiusvis hominis est errare.
It is (the lot) of any man to err.

(2) The partitive genitive is used to express the whole of which the substantive on which it depends is but a part, as in :—

Belgae pertinent ad inferiorem partem **fluminis Rheni**.
The Belgae belong to the lower part of the river Rhine.
Mille et ducenta talenta **praedae** in publicum retulit.
He paid twelve hundred talents of the booty into the public treasury.

It is very commonly used with superlatives, as in :—

Huic coniunx Sichaeus erat, ditissimus **Phoenicum**.
Her husband was Sichaeus, the richest of the Phœnicians.
Phalaris **tyrannorum** crudelissimus erat.
Phalaris was the cruellest of tyrants.

(3) The genitive of material is used to define a noun or show of or in what a thing consists, thus :—

Urbs **Romae**	*The city of Rome.*
Virtus **fortitudinis**	*The virtue of courage.*
Exemplum **magni laboris**	*An instance of great toil.*

(4) The genitive of quality is used with an attributive adjective to express the

inherent or characteristic quality of a thing, thus :—

Vir **maximae eloquentiae** *A man of the greatest eloquence.*
Adolescens **summae audaciae** *A youth of the greatest daring.*

Note that **nostrum** and **vestrum** are used only as partitive genitives of **nostĕr** and **vestĕr**, and **nostrī** and **vestrī** as objective genitives.

(5) The subjective genitive, as already explained, denotes the subject of an implied verb, as in :—

Cura **matris.**
A mother's care (i.e., *the care given by a mother*).
Aedui **Caesaris** indulgentiam in se requirunt.
The Aedui seek the indulgence of Caesar towards themselves.

The Predicative Uses of the Genitive

Most of the genitives just enumerated may be used as secondary predicates, thus :—

Nequissima iniuria est **patris.**
The wickedest injustice is a father's (i.e., *that done to a father*).
Virum **summae audaciae** se praebuit.
He showed himself a man of supreme daring.

Objective Uses of the Genitive

A number of verbs take a genitive of the object or the matter referred to. These include (1) verbs expressing pity, disgust, etc., e.g., the impersonal verbs **mīsĕrĕt**, *to make pity*, **paenĭtĕt**, *to make sorry*, **pĭgĕt**, *to vex*, **pŭdĕt**, *to make ashamed*, **taedĕt**, *to weary*; (2) verbs expressing remembrance, forgetting, reminding, etc.; (3) verbs expressing fullness or want; and (4) verbs expressing accusation, condemnation, acquittal, etc.

(1) Examples of the impersonal verbs expressing pity, etc., are :—

Miserere **mei**, miserere **meorum.**
Pity me, pity my friends.
Miseret te **aliorum**; **tui** te nec miseret nec pudet.
You pity others; for yourself you feel neither pity nor shame.

(2) Verbs expressing remembrance, forgetting, etc., with a complement in the genitive, are exemplified in the following :—

Memini **constantiae tuae.**
I remember your firmness.
Leti meminit **paterni.**
He remembers his father's death.
Nostrae dignitatis obliti.
Forgetful of our worth.

(3) Verbs expressing fullness or want commonly take the ablative; the following are examples of a genitive complement :—

Implentur **veteris Bacchis pinguisque ferinae.**
They satiate themselves with old wine and fat game.
Eget **auxilii.**
He wants help.

(4) After verbs expressing accusation, condemnation, or acquittal, the substantive denoting the charge is put in the genitive, thus :—

Miltiades **proditionis** est accusatus.
Miltiades was charged with treachery.
Ambitus consul condemnatus est.
The consul was convicted of bribery.
Absolvit eum **iniuriarum.**
They acquitted him of wrong-doing.

The impersonal verbs **intĕrest** and **rĕfert**, *it concerns*, are peculiar in construction. In the following examples they are found governing the genitive :—

Multum interest **rei familiaris tuae** te quam primum venire.
It is of much importance to your property that you come as soon as possible.
Plurimum refert **compositionis** quae quibus anteponas.
It is of the utmost importance to composition which words you put before which.

When, however, the person or thing concerned is represented by a personal pronoun the corresponding possessive adjective is used in the ablative singular feminine, **mĕā**, **tŭā**, **vestrā**, **sŭā**, etc., as in :

Quid **meā** refert, hae Athenis natae an Thebae sint?
How does it matter to me whether these women were born at Athens or Thebes?
Tuā et **meā** maxime interest te valere.
It matters very much to you and to me that you are in good health.
Id ego et **mea** et **reipublicae** interesse arbitror.
I think that this concerns both me and the state.

In the last example we find both a noun in the genitive and the ablative of the possessive adjective governed by **intĕrest**.

Many nouns and adjectives implying verbal action, especially those containing the ideas of fullness, want, etc., in short those related in idea to the verbs just considered, are constructed with an objective genitive.

Examples :—

Omnium egeni *Destitute of all things.*
Silvae ditissima terra *A land most rich in woodland.*
Animi maturus Aletes *Aletes mature in mind.*
Manifesti peculatus reus *Accused of manifest peculation.*
Trucidatio **civium** *Butchery of the citizens.*

Exercise 25

Translate into English :—

1. Hoc, meo quidem animo, amoris mei signum debet esse certissimum. 2. Copia frumenti et annona tolerabilis rerum aliarum. 3. Quot capitum vivunt, totidem studiorum milia. 4. Haec est natura propria animae et vis. 5. Totius naturae menti atque animo hoc nomen dei tribuit. 6. Non minus saepe ei venit in mentem potestatis quam aequitatis tuae.

Translate into Latin.

1. Of all the follies I do not know if any is greater. 2. Speeches are extant from which a judgment can be formed of his abilities. 3. The love of coin grows as the money itself grows. 4. The cause of the one leader seemed better, that of the other more powerful. 5. Nothing new is discovered. 6. Accused of extorting money.

E. A. B.

FRENCH.—XXVI

The Position of Pronouns.—WHEN the subject or subjects of a plural verb consist of pronouns of different persons, the verb is in the first person if the pronouns are of the first and second, and in the second person if they are of the second and third. Examples :

Vous et moi sommes de vieux amis,	*You and I are old friends.*
Vous et votre père serez les bien-venus,	*You and your father will be welcome.*

Usually the personal pronoun **nous**, *we*, or **vous**, *you*, is inserted before the verb in these cases, as in—

Vous et moi nous sommes de vieux amis.

When a pronoun is the object of a verb it is placed before the verb, as in **je le veux**, *I wish it ;* **nous l'avons voulu**, *we have wished it.*

When two pronouns occur as direct and indirect objects of a verb, the indirect object precedes the direct object if they are of different persons, as in—

Je vous le donne,	*I give it to you.*
Il me le donne,	*He gives it to me.*
Il nous le donne,	*He gives it to us.*

If they are of the same person, the direct precedes the indirect person, as in—

Nous le lui donnons,	*We give it to him.*
Nous le leur donnons,	*We give it to them.*

With the imperative used affirmatively, the pronouns representing the objects are placed after the verb, the direct object always preceding the indirect, as in—

Donnez-le nous,	*Give it to us.*
Montrez-le-leur,	*Show it to them.*

The disjunctives **toi** and **moi** are used with the imperative, instead of **me** and **te**, as in **assieds-toi**, *sit down.*

With the imperative used negatively, the former rules respecting precedence of pronominal objects hold good, thus—

Ne nous le donnez pas,	*Do not give it to us.*
Ne le lui donnez pas,	*Do not give it to him.*

En and **y** always follow any other pronominal object, but cannot appear both in the same sentence, thus—

Je lui en donne,	*I give him some.*
Il nous y envoie,	*He sends us there.*
Il nous en a envoyé là	*He has sent some to us there.*
Envoyez-leur-en,	*Send some to them.*

The student will remember that the cases in which disjunctive pronouns are preferred to conjunctives are dealt with in the seventh lesson. Disjunctive pronouns are used to represent the direct objects, and placed after the verb, in the following cases :—

(1) When there are several direct objects, as in—

Je les connais, elle et eux,	*I know her and them.*
Je les ai vues elle et sa sœur,	*I saw her and her sister.*
Il les regardait, tantôt elle, tantôt moi,	*He looked now at you, now at me.*

(2) When the verb is accompanied by **ne . . . que**, referring to the pronoun, as in—

Ils n'ont vu que moi,	*They saw me only.*

But—

Je ne l'ai vu que deux fois,	*I saw him twice only.*

In the last example the reference is to the adverbial phrase **deux fois**, not to the pronoun.

Similarly, the indirect object is put after the verb in the following cases :—

(1) When there are several indirect objects, as in—

Je parle à vous et à lui,	*I speak to you and to him.*
J'ai écrit à elles et à leur frère,	*I wrote to them and their brother.*

(2) When the direct object and the indirect object are of the first and the second person, as in—

Il te confiera à nous,	*He will entrust thee to us.*
Le roi m'a envoyé à vous,	*The king sent me to you.*

(3) When the direct object is of the first or second person, and the indirect of the third, as in—

Votre frère vous présentera à eux,	*Your brother will introduce you to them.*
Votre oncle nous a envoyés à elle,	*Your uncle has sent us to her.*

(4) With such verbs as **aller**, *to go*, **accourir**, *to run up*, **courir**, *to run*, **venir**,

to come, **revenir**, *to return*, **penser**, **songer**, *to think*, **appeler**, *to call*, etc., as in—

Elle courut à lui, *She ran up to him.*
Ce cheval est à moi, *This horse belongs to me.*

(5) With idiomatic phrases like **avoir affaire à**, *to have dealings with*, **avoir rapport**, *to concern*, **avoir égard**, *to consider*, **avoir recours**, *to have recourse*, **prendre garde**, *to beware, to heed*, **prendre intérêt**, *to take interest*, **faire attention**, *to pay attention*, etc., as in—

Nous aurons recours à toi, *We shall have recourse to thee.*
Il faut prendre garde à soi, *One must take care of oneself.*

(6) For emphasis sake, as in—

Sachez-le bien, je parle à vous, *Know it well, I speak to you.*

(7) With reflective verbs, as in—

Le ministre s'addressait à eux, *The minister used to apply to them.*

(8) When the verb is accompanied by **ne . . . que** referring to the pronoun, as in—

Je ne parle qu'à vous, *I speak to you alone.*

But—

Elle ne m'a parlé que de son fils, *She spoke to me of nothing but her son.*

VOCABULARY

appuyer, *to support.*	fier, *to trust.*
charger, *to order.*	gracier, *to pardon.*
confier, *to entrust.*	pendant, *during.*
contenter, *to satisfy.*	terminer, *to end.*
empêcher, *to prevent.*	le tuteur, *the guardian.*
l'ennemi, m., *the enemy.*	le voyage, *the voyage, the journey.*

Exercise 49

1. J'ai chargé elle et lui de le faire. 2. Il saura bien empêcher vous et ses autres ennemis de lui nuire. 3. Ils ne connaissent que moi ici. 4. Mon cousin a écrit à toi et à ta sœur. 5. Le ministre a promis à nous et à eux, qu'elle serait graciée. 6. Votre père vous confiera à moi pendant le voyage. 7. Mon frère m'a envoyé à vous hier. 8. Je ne veux pas t'envoyer à lui. 9. Il ne me confiera pas à eux. 10. Il faut songer à soi. 11. Cela a rapport à vous. 12. Il ne se fie pas à toi. 13. Je le déclare à vous, à vous même, que cela est faux. 14. Prenez garde à vous. 15. Il n'écrira qu'à eux. 16. Je les ai vus lui et son père. 17. Je vais chez vous pour parler à votre frère et pour vous voir. 18. J'ai besoin d'argent pour acheter des marchandises. 19. Voulez-vous nous le donner? 20. Je veux vous le prêter.

Exercise 50

1. Can you give them to me? 2. I cannot give them to you. 3. Can your brother send it to him? 4. He will not send it to him. 5. Who will lend it to them? 6. No one will lend it to them. 7. Send them to us. 8. Do not send them to us. 9. Give us some. 10. Do not send them any. 11. Send it to them, to satisfy them. 12. I will send you some there. 13. I can send it to you there. 14. I have seen him and his father. 15. He recognised his mother and her. 16. They have supported thee and thy cousin with all their credit. 17. I know no one here but him. 18. He does not wish to see anyone but her. 19. They are sending us to you to end the (that) matter. 20. My guardian has entrusted me to her because he knows no one but her in this town.

Key to Exercise 42

1. Je m'en suis allé à neuf heures. 2. Cette robe vous va-t-elle bien? 3. Elle ne me va pas bien 4. Cet habit vous sied-il fort bien? 5. Ces livres sont-ils à vous ou à moi? 6. À qui sont-ils donc? 7. Il ne s'en est pas encore allé. 8. Elles s'en sont allées vers six heures de l'après-midi. 9. Il n'est ni à lui ni à moi, il est à mon beau-frère. 10. Où l'a-t-il fait faire? 11. Ils sont à moi. 12. Notre maison ne vaut pas grand'chose. 13. Ce drap ne vaut rien. 14. Elle ne vaut pas grand'chose, elle ne va pas bien. 15. Cette personne est riche d'une centaine de mille francs. 16. Cette maison vaut cinq mille francs. 17. Ce couteau ne vaut-il pas plus que le vôtre? 18. Ne vaut-il pas mieux rester ici que d'aller au marché? 19. Elle ne vaut pas grand'chose, elle est cassée. 20. Nous réjouissons de votre succès.

Key to Exercise 43

1. I leave the house firmly determined not to re-enter it. 2. I must tell you about my expedition in every detail. 3. That is well deserving of the honours of recounting it. 4. Should she whom I seek conceal herself in the depths of the realm of Cathay or Samarkand I shall know well how to discover her. 5. I never could keep my word to anyone, not even to myself. 6. If I say, I shall go there to-morrow, it is certain that I shall stay. 7. If I propose to go to the tavern, I go to church. 8. If I wish to go to church, the ways become entangled beneath my feet like skeins of thread. 9. I went out of the house resolutely, with head high, chin raised, and looking straight before me. 10. I was going along the streets then. 11. It is only the handsome and rich who can be in love without being ridiculous or to be pitied. 12. They are ill, they cannot walk. 13. You see that nothing is lacking. 14. But never in my life shall I be able to do a thing like that. 15. I understand it intellectually, but I do not feel it. 16. There is the spring that moves the machine. 17. They sat down on the staircase. 18. You will see better from here. 19. I have fared badly (I have come to grief). 20. Know that my daughter is getting married.

Key to Exercise 44

1. Par où ces voyageurs sont-ils venus? 2. Combien de temps avez-vous demeuré en Italie? 3. Combien de fois y avez-vous été? 4. Jusqu'à quelle heure avez-vous attendu? 5. D'où venez-vous, mon ami? 6. Par où votre ami est-il allé? 7. Combien de temps va-t-il y rester? 8. Il va y rester jusqu'au printemps. 9. D'où viennent ces anglaises? 10. Par où sont-elles venues? 11. Ne reçutes-vous point votre parent amicalement lorsqu'il vint vous voir? 12. Je le reçus de mon mieux. 13. Nos écoliers s'ennuyèrent-ils hier d'attendre si longtemps? 14. Ils furent obligés d'attendre si longtemps qu'à la fin ils perdirent patience. 15. Ne lûtes-vous pas la lettre de votre frère avant-hier? 16. Pourquoi n'écriviez-vous pas plus vite ce matin? 17. Parce que j'avais peur de me tromper. 18. Je ne sais pas où est mon père. 19. Savez-vous où est Georges? 20. Savez-vous qui vient de frapper à la porte?

E. A. B.

GERMAN.—XXIII.

Order of the Verbal Adjuncts. — In a sentence which has the normal order, i.e. one in which the subject is placed first and is followed by the verb, all the verbal adjuncts are placed after the verb.

When the verb in such a sentence has two or more adjuncts, the general rule is that those adjuncts which are most intimately connected with the verb are placed farther away at the end, while those more remotely connected are placed near it.

It is, of course, impossible to give rules for every sentence, and any word may be moved from its normal position to a more prominent one which will give it emphasis, but, generally speaking, the student will find that the following apply:

1. When one object is a noun and the other a pronoun, the pronoun is placed first. Thus: ſie gab ihm Wein, *she gave him wine;* ich brachte es meinem Vater, *I brought it to my father.*

2. When both objects are nouns the following applies:

(*a*) Both nouns in the accusative, the direct object precedes the objective complement. Thus: er nannte meinen Bruder einen Narren, *he called my brother a fool.*

(*b*) One noun in the accusative and one in the genitive, the accusative precedes the genitive. Thus: er klagte den Mann des Mordes an, *he accused the man of murder.*

(*c*) When one noun is in the accusative and one in the dative, the dative precedes the accusative. Thus: ich reichte der Dame den Teller, *I handed the plate to the lady.*

3. When both objects are pronouns the usual order is as follows: reflexive pronoun, es, accusative of personal pronoun, dative or genitive of personal pronoun, demonstrative pronouns. Thus: ich erinnere mich deſſen, *I remember that;* er gab es mir, *he gave it to me;* ich lehrte es ihn, *I taught it to him;* er hat ihn deſſen angeklagt, *he accused him of that.*

However, the pronoun es may precede the reflexive. Thus: er hat es ſich überlegt, *he has thought it over.* Sometimes it is used enclitically after mir, mich, etc. Thus we may say ich habe es mir überlegt or ich habe mir's überlegt.

Adverbs and prepositional phrases are placed as near the end of the sentence as possible, when they are emphatic.

Adverbs like beſonders, nicht, noch, nur, ſelbſt, ſogar, vorzüglich (especially), when they modify particular words in the sentence, are placed before those words. Thus: ich habe ihn nur heute geſehen, *I saw him only to-day;* but ich habe nur ihn heute geſehen, *I saw only him to-day;* and ich habe ihn heute nur geſehen, *I only saw him to-day* (I did not speak to him, but only saw him).

In general, adverbial adjuncts precede the object, unless the object be a pronoun. Thus: ich ſah nirgends einen Menſchen, *I saw no human being anywhere* (I saw a human being nowhere); ich habe geſtern einen Spaziergang gemacht, *I went for* (made) *a walk yesterday.*

Unemphatic adverbs like oft, doch, precede everything except pronouns.

Adverbs and adverbial phrases of time precede those of place, and those of place precede those of manner, unless any special emphasis is laid on one or the other. Thus: ich gehe heute dorthin, *I am going there to-day;* ſie ſpielte in dem Konzert ſehr ſchön, *she played very beautifully at the concert.*

When used to negative a whole sentence, nicht stands next to the verb in a principal clause, and next to the finite verb or just before the participle in a dependent clause. Thus: ſie kam nicht vor drei Uhr an, *she did not arrive before three o'clock;* ich höre daß ſie vor drei Uhr nicht angekommen iſt, *I hear that she did not arrive before three o'clock.*

Participles and Infinitives, as has been stated before, are placed at the end of a sentence, whether they form part of a compound tense or are dependent on some modal auxiliary. Thus: er hat nie einem Menſchen etwas zu Leide getan, *he never did any man any harm;* ich werde jedenfalls vor Ende dieſer Woche nach Hauſe reiſen, *I shall certainly go home before the end of this week.*

As a rule, in dependent clauses the finite verb comes right at the end, after the participle or infinitive; but in compound tenses of the modal auxiliaries and other verbs like ſehen, hören, etc., the finite verb precedes the infinitives. Thus: er ſagte daß ſie heute Nachmittag kommen werde, *he said that she would come this afternoon;* ſie hat ihn gefragt ob er heute kommen könnte, *she asked him whether he could come to-day;* but er ſagte daß ſie heute nicht wird kommen können, *he said that she would not be able to come to-day.*

Separable prefixes are also placed at the end, as are the separable parts of verbs compounded with adverbs, etc. Thus: heute fangen alle Schulen in der Stadt wieder an, *to-day all the schools in the town open* (begin) *again;* er nahm ſofort die Lage der Dinge wahr, *he immediately grasped* (saw) *the position of affairs.*

Moods and Tenses.—The use of the indicative mood in German corresponds pretty closely to its use in English.

The Present Tense.—This stands for the three English forms of the present, i.e. ich liebe stands for *I love, I am loving, and I do love.* The student must judge in each particular case which of the English forms is the most suitable to the context. The present is used as in English, and still oftener in French, to give vividness to a narrative which refers to the past. This is the so-called Graphic or Historic Present.

The German Present also corresponds to the English Present Perfect. Thus it is used to indicate that an action or a state of affairs that existed in the past still obtains in the present. Thus: er lebt ſchon ſeit zehn Jahren in London, *he has lived in London for ten years* (he lives in London since ten years).

Very often in German the present is used to indicate the future. Thus: ich reiſe morgen nach Schottland, *I go to-morrow to Scotland.*

The Preterite Tense.—This again corresponds to the three English forms of the past, i.e. ich liebte stands for *I loved, I was loving,* and *I did love.*

Just as the German Present is used for the English Present Perfect, so the German Preterite is used for the English Pluperfect. Thus: waren Sie ſchon lange da als er ankam? *had you been there long when he arrived?*

The Present Perfect Tense.—This, though it corresponds in form to the English Present Perfect, rarely corresponds to it in meaning. It can stand for both the English forms, i.e. ich habe geliebt may stand for *I have loved* or *I have been loving.* Thus: ich habe ſie ſchon oft geſehen, *I have often seen her.* It is, however, very often used where we should use the English Past. Thus: er hat ſie geſtern geſehen, *he saw her yesterday.*

The student must clearly realise that in German the Perfect is a past tense and does not, as a rule, connect the action in any way with present time. Thus in English we say, "I have been out this morning" (implying that the day is not yet over); we can never say, "I have been out yesterday," where the word "yesterday" fixes the action in the past and excludes all reference to the present. But in German the Perfect can be used with equal propriety in either case.

The Pluperfect Tense.—This stands for both the English forms, i.e. ich hatte geliebt, *I had loved* and *I had been loving.*

Future and Future Perfect Tenses.—These stand for both the English forms, i.e. ich werde lieben, *I shall love* and *I shall be loving;* ich werde geliebt haben, *I shall have loved* and *I shall have been loving.*

The student is warned to be careful in translating "shall" and "will"; when these are used as auxiliaries they must be translated by the German Future, but when they are used as notional verbs they must be translated by the modal auxiliaries ſollen and wollen. Thus: *I shall go to-morrow,* ich werde morgen gehen, but *you shall go* (whether you will or no); Sie ſollen gehen (ob Sie es wollen oder nicht).

VOCABULARY

Traum, s.m.2, *dream.*
Märchen, s.n.1, *fairy tale.*
Brunnen, s.m.1, *well.*
Schlaf, s.m., *sleep.*
Zauber, s.m.1, *magic.*
Grube, w.f., *pit, mine.*
Seite, w.f., *side.*
ſtürzen, w., *to rush.*
Zwerglein, s.m.1, *little dwarf.*
zornig, *angry, wrathful.*
Schwert, s.n.3, *sword.*
gellend, *shrill.*
eilen, w., *to hurry.*
entſetzlich, *horrible.*
Haupt, s.n.3, *head.*
Blut, s.n., *blood.*
merken, w., *to notice.*
bärtig, *bearded.*
Stock, s.m.2, *stick.*
gleich, *immediately.*
hell, *light.*
Saal, s.m.2, *hall.*
weiß, *white.*
Bildſäule, w.f., *statue.*
küſſen, w., *to kiss.*
blenden, w., *to dazzle.*
zuſammenrennen, s., *to run together.*
wüſt, *desolate.*
jagen, w., *to rush, speed.*
verſtorben, *dead.*
klatſchend, *cracking.*
buntſcheckig, *many-coloured.*
Ungetüm, s.n.2, *monster.*
langen, w., *to reach out.*
Kralle, w.f., *talon, claw.*
erwachen, w., *to awake.*
verſcheuchen, w., *to expel, drive out.*
hinabſteigen, s., *climb down.*
ſtarr, *stiff, numb.*
verwünſchen, w., *to curse, bewitch.*
plötzlich, *suddenly.*
Loch, s.n.3, *hole.*
wachſam, *watchful.*
ſchneiden, s., *to cut.*
hauen, s., *to hit, strike.*
blaſen, s., *to blow.*
Horn, s.n.3, *horn.*
wackeln, w., *to wag.*
breit, *wide, broad.*
zu'ſchlagen, s., *to strike at.*
heraus'fließen, *to flow out.*
blühen, w., *to bloom.*
Diſtel, w.f., *thistle.*
ab'ſchlagen, s., *to hit* or *cut off.*
gelangen (in), w., *to reach, get to.*
Pracht, s.f., *grandeur, splendour.*
Mitte, w.f., *middle.*
verſchleiern, w., *to veil.*
regungslos, *motionless.*
Mund, s.m., *mouth.*
ſchießen, s., *to shoot.*
chaotiſch, *chaotic.*
gären, w.s., *to ferment.*
ängſtlich, *afraid.*
Geſpenſt, s.n.3, *ghost.*
hetzen, w., *to hunt.*
Peitſche, w.f., *whip.*
Harlekin, s.m.2, *harlequin.*
mißgeſtaltet, *misshapen.*
aus'breiten, w., *to spread out.*
Entſetzen, s.n.1, *horror.*

Exercise 53

Ich aber lebte noch in dem Traume der vorigen Nacht, den ich nicht aus meiner Seele verſcheuchen konnte. Es war das alte Märchen, wie ein Ritter hinabſteigt in einen tiefen Brunnen, wo unten die ſchönſte Prinzeſſin zu einem ſtarren Zauberſchlafe verwünſcht iſt. Ich ſelbſt war der Ritter, und der Brunnen die Klauſtaler[2]

Grube, und plötzlich erschienen viele Lichter, aus allen Seitenlöchern stürzten die wachsamen Zwerglein, schnitten zornige Gesichter[3], hieben nach mir mit ihren kurzen Schwertern, bliesen gellend ins Horn, daß[4] immer mehr und mehr herzu[5] eilten, und es[6] wackelten entsetzlich ihre breiten Häupter. Wie ich darauf zuschlug und das Blut herausfloß, merkte ich erst, daß es die rotblühenden, langbärtigen Distelköpfe waren, die ich den Tag vorher an der Landstraße mit dem Stocke abgeschlagen hatte. Da waren sie auch gleich alle verscheucht, und ich gelangte in einen hellen Prachtsaal; in der Mitte stand, weiß verschleiert, und wie eine Bildsäule starr und regungslos, die Herzgeliebte, und ich küßte ihren Mund . . . Es war mir, als hörte ich, wie Gott rief: „Es werde Licht," blendend schoß herab ein Strahl des ewigen Lichtes; aber in demselben Augenblicke wurde es wieder Nacht und alles rann chaotisch zusammen in ein wildes, wüstes Meer. Ein wildes, wüstes Meer! über das gärende Wasser jagten ängstlich die Gespenster der Verstorbenen, ihre weißen Totenhemden[7] flatterten im Winde, hinter ihnen her[8], hetzend, mit klatschender Peitsche lief ein buntscheckiger Harlekin, und dieser[9] war ich selbst — und plötzlich, aus den dunkeln Wellen, reckten die Meerungetüme ihre mißgestalteten Häupter, und langten nach mir mit ausgebreiteten Krallen, und vor Entsetzen erwacht' ich.

H. Heine.

NOTES:

(1) vorig, an adjective formed from the preposition vor before; it is used with regard to time as we use "last." (2) Klaustaler, an adjective formed from the name Klaustal. (3) Gesichter schneiden, *to make faces.* (4) daß, *so that.* (5) herzu, this should here be translated *thither*, but as they are supposed to come towards the persons concerned, the Germans use her instead of hin. (6) es—temporary grammatical subject; the logical subject is Häupter. (7) Totenhemden, *shirts of the dead*, i.e. shrouds. (8) hinter ihnen her, literally, *behind in their direction*, i.e. in their wake. (9) dieser—this is a demonstrative pronoun here.

VOCABULARY.

vigilant, vorsichtig.
information, Nachricht, w.f.
party, Partei, w.f.
narrow, schmal.
get through, durchkommen, s (sep.).
edge, Rand, s.m.3.
accordingly, also.
troop, Truppe, w.f.
swift-running, reißend.
steep, steil.
bank, Ufer, s.n.1
ford, Furt, w.f.
receive, bekommen, s.
intention, Vorhaben, s.n.1.
come upon = attack, überfallen, s.
quarter, stationieren, w.
on the side, bei.
river, Fluß, s.m.2, Strom, s.m.2.
rocky, felsig.
but, nur.
cross, passieren, w.
scarcely, kaum.
abreast, neben einander.
difficult, schwierig.

Exercise 54

The good king Robert Bruce, who was always watchful and vigilant, had received some[1] information of the intention of this party to come upon him suddenly and by night[2]. Accordingly[3] he quartered his little troop of sixty men on the side of a deep and swift-running river that[4] had very steep and rocky banks. There was but one ford[5] by which this river could be crossed in that neighbourhood, and that ford was deep and narrow, so that two men could scarcely get through abreast. The path that led upwards from the water's edge to the top[6] of the bank was extremely narrow and difficult.

Sir Walter Scott.

NOTES:

(1) Omit *some.* (2) Say, *in the night.* (3) also must be placed after the verb. (4) Say, *whose banks were.* (5) Say, *the river had only one ford in that neighbourhood by which one could cross.* (6) Omit *the top of.*

Key to Exercise 51

A wonderful joy has encompassed my whole soul, like the sweet spring mornings which I enjoy with all my heart. I am alone and rejoice in my life in this countryside (neighbourhood), which seems made for such souls as mine. I am so happy, my dear fellow, so completely steeped in the feeling of quiet existence, that my art suffers thereby. I could not draw now, not a line, and have never been a greater artist than in these moments. When the sweet valley around me is veiled in mist (steams around me), and the sun rests on the surface of the impenetrable darkness of my forest, and only single rays steal into the shrine, when I then lie in the high grass by the falling brook, and nearer to the earth a thousand little grasses of many kinds grow remarkable in my eyes (to me); when I feel that the swarm of little beings (world) among the grass blades, the innumerable, unfathomable forms of the little worms and the little gnats are nearer to my heart, and feel the presence of the Almighty Who created us in His image, the breath of the All-loving Who bears and upholds us hovering in eternal bliss—my friend, if then my eyes grow dim, and the whole world around me and the heavens are enshrined (rest) in my soul like the form of my love (a loved one); then I am often filled with longing and think: Ah, if only I could reproduce that, if I could imbue the paper with that which lives so fully and so ardently in my heart (in me), so that it might be the mirror of my soul as my soul is the mirror of eternal God . . . my friend. . . . But I perish beneath (over) it, I succumb beneath the intensity (force) of the splendour of these things (phenomena).

Key to Exercise 52

„Sie haben keine besonderen Vorzüge," erwiederte er, „sie sind alle albern und ungebildet wie andere Mädchen."

„Bennet, wie kannst du nur deine eignen Kinder auf solche Weise beschimpfen? Es macht dir Vergnügen mich zu ärgern. Du hast kein Mitleid mit meinen armen Nerven."

„Du irrst, meine Liebe, ich habe die größte Achtung vor deinen Nerven. Sie sind alte Freunde. Seit mindestens zwanzig Jahren sprichst du mit Rücksicht von ihnen."

„Ach, du weißt nicht wie ich leide."

„Ich hoffe doch daß du es überwinden wirst und daß du es noch erleben wirst daß viele jungen Leute mit einem Einkommen von vier tausend Pfund jährlich in die Gegend ziehen werden."

„Es wird uns doch nichts nützen wenn auch zwanzig solche kämen, da du sie nicht besuchen willst."

„Verlasse dich darauf, meine Liebe, wenn zwanzig da sind, werde ich sie alle besuchen."

M. A. L.

RUSSIAN.—XIII

The Adjective

146. THE Adjectives are mostly formed from Nouns by assuming a variety of endings, as exemplified below:

Nouns	*Adjectives*
День, *a day.*	Дне́вный, *the day's, daily.*
Ночь, *the night.*	Ночно́й, *nocturnal, the night's.*
У́тро, *the morning.*	У́тренній, *matinal, the morning's.*
Ве́черъ, *the evening.*	Вечёрній, *the evening's.*
Недѣля, *the week.*	Недѣльный, *weekly.*
Двѣ недѣли, *two weeks, a fortnight.*	Двухнедѣльный, *fortnightly.*
Мѣсяцъ, *a month.*	Мѣсячный, *monthly.*
Годъ, *a year.*	Годово́й, годи́чный, *yearly, annual.*
Сезо́нъ, *the season.*	Сезо́нный, *the season's.*
Весна́, *spring.*	Весе́нній, *of spring.*
Лѣто, *summer.*	Лѣтній, *of summer.*
О́сень, *autumn.*	Осе́нній, *of autumn.*
Зима́, *winter.*	Зи́мній, *of winter.*
Домъ, *house.*	Дома́шній, *domestic.*
Го́родъ, *a town.*	Городско́й, *of town, urban.*
О́бщество, *society, company.*	Обще́ственный, *social.*
Банкъ, *a bank.*	Банки́рскій, банко́вый, *of a bank.*
Бума́га, *paper, cotton.*	Бума́жный, *of paper, cotton.*
Шёлкъ, *silk.*	Шёлковый, *of silk.*
Лёнъ, *flax.*	Льняно́й, *flaxen, linen.*
Пе́нька, *hemp.*	Пе́ньковый, *of hemp.*
Плати́на, *platinum.*	Плати́новый, *of platinum.*
Де́рево, *wood.*	Деревя́нный, *wooden.*
Фа́брика, *a factory.*	Фабри́чный, *of factory.*
Спи́чка, *a match.*	Спи́чечный, *of matches.*
Таба́къ, *tobacco.*	Таба́чный, *of tobacco.*
Ко́жа, *leather.*	Ко́жанный, *of leather.*
Инжене́ръ, *an engineer.*	Инжене́рный, *engineering.*
Гора́, *a hill, mountain.*	Го́рный, *mining.*

Predicative Adjectives

147. When a qualifying Adjective is to be used in the sentence as predicate, it is placed then after the noun and its full ending is reduced, when hard, to **-ъ**, **-а**, **-о**, and, when soft, to **-ь**, **-я**, **-е**, for Masculine, Feminine, and Neuter Singular respectively, and to **-ы** and **-и** for all genders in Plural.

Examples:

Молодо́й прика́щикъ, *a young clerk.*	Прика́щикъ мо́лодъ, *the clerk is young.*
Че́стный купе́цъ, *an honest merchant.*	Купе́цъ че́стенъ, *the merchant is honest.*
Дёшевая поку́пка, *a cheap bargain.*	Поку́пка дёшева, *the bargain is cheap.*
До́брое и́мя, *a good name.*	И́мя до́бро, *the name is good.*
Ло́жные слу́хи, *false rumours.*	Слу́хи ло́жны, *the rumours are false.*
Но́выя мо́ды, *new fashions.*	Мо́ды но́вы, *the fashions are new.*
Си́ній цвѣтъ, *the blue colour.*	Цвѣтъ синь, *the colour is blue.*
Си́няя са́ржа, *the blue serge.*	Са́ржа синя́, *the serge is blue.*

Degrees of Comparison

148. The endings of the Positive degree are such as given in the Rules 124 and 147.

149. The Comparative degree of Adjectives with full endings is: ѣйшій, -ѣйшая, -ѣйшее, for Masculine, Feminine, Neuter Singular, and -ѣйшіе, -ѣйшія, -ѣйшія, for Masculine, Feminine, Neuter Plural respectively. (See also Rule 152.)

Examples:

Добрѣйшій хозя́инъ.	*A better master.*
Бѣлѣйшая бума́га.	*The whiter paper.*
Честнѣйшіе лю́ди.	*More honest people.*
Богатѣйшія компа́ніи.	*Richer companies.*
Прія́тнѣйшія извѣстія.	*More pleasant news, tidings.*

150. The Comparative degree of the Predicative Adjectives (see Rule 147) is: **-ѣе**, for all Genders and Numbers.

Examples:

Онъ добрѣе, бѣднѣе, умнѣе. *He is better, poorer, wiser.*
Она́ добрѣе, бѣднѣе, умнѣе. *She is better, poorer, wiser.*
Оно́ добрѣе, бѣднѣе, умнѣе. *It is better, poorer, wiser.*
Они́ добрѣе, бѣднѣе, умнѣе. *They* (m.) *are better, poorer, wiser.*
Онѣ́ добрѣе, бѣднѣе, умнѣе. *They* (f.) *are better, poorer, wiser.*
Они́ добрѣе, бѣднѣе, умнѣе. *They* (n.) *are better, poorer, wiser.*

151. The following form exceptions to the preceding rule in the way of forming the Comparative degree:

Positive	*Comparative*
Хоро́шъ -а -о -и, *good, nice.*	Лу́чше, *better, nicer.*
Плохъ -а -о -и, *bad* (in health, time, work, state).	Пло́ше, *worse.*
Худъ -а -о -ы, *bad* (in quality, conditions, etc.).	Ху́же, *worse.*
Широ́къ -а -о -и, *large, wide.*	Ши́ре, *larger, wider.*
У́зокъ, узка́, у́зко, у́зки, *narrow.*	У́же, *narrower.*
Вели́къ -а -о -и, *big, great.*	Бо́льше, *bigger, greater, more.*
Малъ -а -о -ы, *little, small.*	Ме́ньше, *less, smaller.*
Высо́къ -а -о -и, *high, tall.*	Вы́ше, *higher, taller.*
Ни́зокъ, ни́зка́, ни́зко, ни́зки, *low.*	Ни́же, *lower.*
Сухъ -а -о -и, *dry.*	Су́ше, *drier.*

Positive	*Comparative*
Толстъ -а -о -ы, *thick.*	То́лще, *thicker.*
То́нокъ, тонка́, то́нко, то́нки, *thin, fine.*	То́ньше, *thinner, finer.*
До́рогъ -а -о -и, *dear.*	Доро́же, *dearer.*
Дёшевъ -а -о -ы, *cheap.*	Дешёвле, *cheaper.*
Твёрдъ -а -о -ы, *hard.*	Твёрже, *harder.*
Мя́гокъ, мя́гка́, мя́гко, мя́гки, *soft.*	Мя́гче, *softer.*
Бога́тъ -а -о -ы, *rich.*	Бога́че, *richer.*
Густъ -а -о -ы, *dense.*	Гу́ще, *more dense.*
Рѣ́докъ, рѣдка́ рѣдко, рѣ́дки, *rare, scarce, sparse.*	Рѣ́же, *rarer, scarcer, more sparse.*
Чистъ -а -о -ы, *clean.*	Чи́ще, *cleaner.*
Старъ -а -о -ы, *old.*	Ста́рше, *of an older age.*
Мо́лодъ -а -о- -ы, *young.*	Моло́же, *younger.*
Крѣ́покъ, крѣпка́, крѣпко, крѣпки, *strong.*	Крѣ́пче, *stronger.*
Глубо́къ -а -о -и, *deep.*	Глу́бже, *deeper.*
Строгъ -а -о -и, *strict.*	Стро́же, *stricter.*

152. Instead of forming the Comparative degree of Adjectives with full endings in the way shown in Rule 149, preference is now given to the use of the Positive degree by placing before it the adverb **бо́лѣе**, *more.*

Positive	*Comparative*
Дёшевый, *a cheap one.*	Бо́лѣе дёшевый, *a cheaper one.*
Стро́гій, *strict.*	Бо́лѣе стро́гій, *stricter.*

153. The Comparative degree with the endings shown in Rule 149 is also invariably used as the Superlative degree. Sometimes the particle "**наи**" is prefixed to them, or the pronoun "са́мый" is placed before them.

154. Thus, the full Adjective бѣдный, *poor*, taken as Positive degree, will be in the Comparative: Бѣднѣйшій or Бо́лѣе бѣдный, *poorer*, and in the Superlative: Бѣднѣйшій, Наибѣднѣйшій, Са́мый бѣднѣйшій, *poorest.*

155. Other expressions of the Superlative degree are: Бѣднѣйшій изъ всѣхъ; наибѣднѣйшій изъ всѣхъ; са́мый наибѣднѣйшій; са́мый бѣдный.

156. Adjectives ending in **-гій**, **-кій**, **-хій** have in the Comparative and Superlative degrees the endings: -жайшій, -чайшій, and -шайшій respectively.

Examples:

До́лгій, *long.*	Долга́йшій, *longer, longest.*
Кра́ткій, *short.*	Кратча́йшій, *shorter, shortest.*
Ти́хій, *quiet.*	Тиша́йшій, *quieter, quietest.*

157. The following Adjectives form their Comparative and Superlative degrees differently from the Rules 149 and 156.

Positive	*Comparative and Superlative*
Дёшевый, *cheap.*	Дешёвшій
Дале́кій, *far.*	Да́льшій
Бли́зкій, *near.*	Ближа́йшій
Дорого́й, *dear.*	Дража́йшій
Высо́кій, *high.*	Вы́сшій and Высоча́йшій
Ни́зкій, *low.*	Ни́зшій and нижа́йшій
Ста́рый, *old.*	Ста́ршій and старѣ́йшій
Худо́й, *bad.*	Ху́дшій
Большо́й, вели́кій, *great.*	Бо́льшій and велича́йшій
Молодо́й, *young.*	Мла́дшій
Ма́лый, *little.*	Ме́ньшій
Хоро́шій, *good.*	Лу́чшій

VOCABULARY

У меня́ есть, *I have.*
Ма́ленькій, *small.*
Нѣсколько, *several, a few, somewhat.*
Подъ бандеро́лью, *under cover, band.*
Обра́зчикъ, *sample.*
Ещё, *more.*
Обяза́ть (P.), *to oblige.*
Пока́мѣсть, *meanwhile.*
Краткосро́чный, *short, of short term.*
Подпи́сывать (It.), *to sign.*
Отказа́ть (P.), *to refuse.*
Этимъ, *by this.*
Оказа́ть (P.), *to render.*
Услу́га, *a service.*
Ста́вить (P.), *to put.*
Нело́вкій, *awkward.*
Положе́ніе, *position.*
Ну́жный, *needed.*
Учёть, *discount.*
Такъ то́чно, *just so.*
Обѣща́ть (Imp.), *to promise.*
Вплати́ть (P.), *to pay in.*
Счёть, *account.*
Поря́дочный, *fair, nice.*
Су́мма, *a sum.*
Въ тече́ніи, *during.*
Сей, *of this.*
Тако́й слу́чай, *such a case.*
Телегра́фный, *telegraphic.*
Перево́дъ, *draft.*
Па́ра, *a couple.*
Отпусти́ть (P.), *to sell, deliver, give.*
Зави́сѣть (Imp.), *to depend on.*
Величина́, *bulk.*
Заказа́ть (P.), *to order.*
Ты́сяча, *a thousand.*
По́лный, *a full.*
Допусти́ть (P.), *to allow.*
Проце́нтъ, *per cent.*
Ски́дка, *allowance, discount.*
Недоста́точно, *insufficient.*
Разсчи́тывать (It.), *to reckon on, calculate*
По кра́йней мѣ́рѣ, *at least.*
Чѣмъ, *than.*
Хорошо́, *very well, all right.*
Согла́сный, *agreeable.*
Задержи́вать (It.), *to detain.*
Увѣря́ть (It.), *to assure.*
Вы́полненъ, *executed.*
Аккура́тный, *accurate.*
Образъ, *way, manner.*
Кра́йній, *lowest.*
Вре́мя, *time.*
Доста́вка, *delivery.*
Жела́ть (Imp.), *to want.*
Кредѝтъ, *credit.*
Но, *but.*
Полови́на, *half.*
Отпра́вка, *shipment.*
Должна́ быть, *will have to be.*
По́слана, *sent.*
Неме́дленно, *immediately.*
По, *on, after.*
Разсмотрѣ́ніе, *examining.*
Нахожде́ніе, *finding.*
Его́, *it.*
Въ поря́дкѣ, *in order.*
Оста́токъ, *balance.*
Нали́чными, *in cash.*
Уважа́емый, *esteemed.*
Благодари́ть (Imp.), *to thank.*
Запро́съ, *inquiry.*
Перемѣна, *change.*
Подтверди́ть (P.), *to confirm.*
Вышеска́занный, *above.*
Надѣ́яться (Imp.), *to hope.*
Найти́ (P.), *to find.*
Вы́годнымъ, *advantageous.*
Для Васъ, *for you.*
Воспо́льзоваться (P.), *to avail of.*
Предложе́ніе, *offer.*
Жале́ть (Imp.), *to spare.*
Стара́нія, Труды́, *efforts.*
Удовлетвори́ть (P.), *to satisfy.*
Во всѣхъ отноше́ніяхъ, *in every respect.*
Любе́зный, *kind.*
Записа́ть на (P.), *to enter to the . . .*
Мнѣ прія́тно, *it is pleasant to me.*
Сообщи́ть (P.), *to inform.*
На про́шлой недѣ́лѣ, *last week.*
По́слѣ, *after.*
Рабо́та, *work.*
Обыкнове́нно, *usually.*
Прогу́лка, *a walk.*
Ба́нковый, *banking.*
Вполнѣ́, *quite.*
Удовлетвори́тельный, *satisfactory.*
По́льзоваться (Imp.), *to enjoy.*
Придава́ть (Imp.), *to attach.*

Уви́дѣть (P.), *to see.*
Тогда́, *then.*
Намѣре́ваться (It.), *to intend.*
Увѣдоми́ть (P.), *to let know.*
Значе́ніе, *importance.*
Вы́йти (P.), *to come out.*
Въ бу́дущій, *next.*
Краси́въ, *nice.*
Тяжёлый, *heavy.*

Exercise 22

. У меня́ есть для Васъ ма́ленькій зака́зъ на нѣсколько кусо́къ си́ней и чёрной (black) са́ржи.

2. Я Вамъ вчера́ вы́слалъ подъ банлеро́дью мои́ лу́чшіе обра́зчики.

3. Мнѣ ну́жно бо́льше де́негъ, чѣмъ Вы мнѣ присла́ли.

4. Я Вамъ пришлю́ ещё пятьсо́тъ рубле́й че́резъ двѣ недѣли.

5. Не мо́жете ли меня́ обяза́ть пока́мѣсть краткосро́чнымъ ве́кселемъ?

6. Я не люблю́ подпи́сывать векселе́й.

7. Пожа́луйста, не откажи́те. Вы мнѣ э́тимъ ока́жете большу́ю у́слугу.

8. Вы меня́ ста́вите въ очень нело́вкое положе́ніе.

9. Ну́женъ ли Вамъ мой ве́ксель для учёта въ ба́нкѣ?

10. Такъ то́чно. Я обѣща́лъ моему́ банкиру вплати́ть поря́дочную су́мму на мой счётъ въ тече́ніи сей недѣли.

11. Въ тако́мъ слу́чаѣ я Вамъ пришлю́ телегра́фный перево́дъ че́резъ па́ру дней.

12. Мо́жете ли Вы мнѣ тепе́рь отпусти́ть вельвети́ны нѣсколько дешёвле?

13. Это зави́сить отъ величины́ зака́за.

14. Я закажу́ одну́ ты́сячу по́лныхъ кусо́къ.

15. Въ тако́мъ слу́чаѣ я допущу́ Вамъ ещё (more) два проце́нта ски́дки.

16. Это недоста́точно. Я разсчи́тывалъ, по кра́йней мѣрѣ, на пять проце́нтовъ.

17. Я Вамъ дамъ пять проце́нтовъ, е́сли (if) возьмёте не ме́ньше, чѣмъ три ты́сячи кусо́къ.

18. Хорошо́. Я согла́сенъ. Но не заде́рживайте зака́за, а высыла́йте его́ чѣмъ скорѣе.

19. Увѣря́ю Васъ, что Вашъ зака́зъ бу́детъ вы́полненъ са́мымъ аккура́тнѣйшимъ и быстрѣйшимъ (rapid, quick, speedy) о́бразомъ.

20. Хорошо́. **Уви́димъ.** Тогда́ полу́чите но́вый зака́зъ.

Exercise 23

1. I have received your newest samples, and I intend to buy one thousand pieces of the black cloth.

2. Let me know by telegram your lowest prices and the time of delivery.

3. I do not want any credit, but half of the shipment will have to be sent free (свобо́дно).

4. Immediately on my examining the goods and finding them (sg.) in order, I shall send you the balance in cash.

5. I have received your esteemed letter, and thank you for the inquiry.

6. I have telegraphed to you: "Old prices without change, two months delivery."

7. I confirm the above telegram, and hope that you will find it advantageous for you to avail yourself of my offer.

8. I may assure you that I shall spare no efforts to satisfy you in every respect.

9. I thank you for the kind order and draft for five hundred (на пятьсо́тъ) pounds (фунтъ), which I have entered to the credit of your account.

10. It is most (о́чень) pleasant to me to inform you that I have received your goods last week in the best order (condition).

11. After the day's work I usually go for a walk.

12. The winter season is better for business than the summer (adjective).

13. My banking account is quite satisfactory.

14. This firm enjoys a good name.

15. I do not attach any importance to false rumours.

16. The new fashions will come out next month.

A. C.

GREEK.—I

Introductory.—Greek is a member of the great family of languages known as the Indo-European or Aryan family, of which the oldest form is Sanskrit, or the ancient language of northern India, and to which belong old Persian and Zend, the Teutonic (embracing German, Dutch, English, and the Scandinavian languages), the Celtic, the Slavonic, the Italian languages, including Latin, and the Romance languages, largely derived from Latin. If the student has learned any Latin he will notice many resemblances to Greek, not only in the roots of words, but also in the structure of the language. Both are inflected languages, that is, they show the relations of words to each other in the sentence by means of changes of form, particularly of the terminations of words.

Alphabet

Letters		*English*	*Greek*	
Capital	*Small*	*Equivalents*	*Name*	
Α	α	a	Ἄλφα	Alpha
Β	β	b	Βῆτα	Bēta
Γ	γ	g (*hard*)	Γάμμα	Gamma
Δ	δ	d	Δέλτα	Delta
Ε	ε	e (*short*)	Ἒ ψιλόν	Epsĭlon
Ζ	ζ	z	Ζῆτα	Zēta
Η	η	e (*long*)	Ἦτα	Ēta
Θ	θ	th	Θῆτα	Thēta
Ι	ι	i	Ἰῶτα	Iōta
Κ	κ	k	Κάππα	Kappa
Λ	λ	l	Λάμβδα	Lambda
Μ	μ	m	Μῦ	Mu
Ν	ν	n	Νῦ	Nu
Ξ	ξ	x	Ξῖ	Xi
Ο	ο	o (*short*)	Ὂ μῑκρόν	Omĭcron
Π	π	p	Πῖ	Pi
Ρ	ρ	r	Ῥῶ	Rho
Σ	σ ς	s	Σίγμα	Sigma
Τ	τ	t	Ταῦ	Tau
Υ	υ	u (*or Latin* y)	Υ̓͂ ψιλόν	Upsĭlon
Φ	φ	ph	Φῖ	Phi
Χ	χ	kh	Χῖ	Chi (pron. *ki*)
Ψ	ψ	ps	Ψῖ	Psi
Ω	ω	o (*long*)	Ὦ μέγα	Ōměga

Besides the twenty-four letters given above there was another consonant *F* called vau or digamma, pronounced like *v* or *w*, which survived in pronunciation at the time when the Homeric poems were composed. The letter γ is pronounced like *ng* when it occurs before γ, κ, ξ, or χ, as in Ἄγγης, pron. gang'gēz, σιγκοπή, sung'ko pe, λάρυγξ, lar'unx.

Two forms σ and ς are given of the letter sigma. At the end of the word the form ς is used, and elsewhere the form σ, as in δρασμός.

Vowels and Diphthongs

There are seven vowels, α, ε, η, ι, ο, ω, υ, which may be classified thus:—

Short	*Long*	*Indeterminate*
ε, ο.	η, ω.	α, ι, υ.

Those marked indeterminate are sometimes short and sometimes long. When these are to be pronounced long they are often printed thus: ᾱ, ῑ, ῡ, when short, thus: ᾰ, ῐ, ῠ.

The diphthongs, or double sounds, produced by a union of these are:—

αι	pronounced	like	*ai*	in *aisle* *	as in	*αἰτία*
ει,	,,	,,	*ei*	,, *height*	,,	*εἶδος*
αυ,	,,	,,	*au*	,, *caught*	,,	*αὖθις*
ου,	,,	,,	*ou*	,, *bound*	,,	*οὐρανός*
ευ,	,,	,,	*yew*	,, *feudal*	,,	*εὕρηκα*
οι,	,,	,,	*oi*	,, *point*	,,	*οἶνος*
υι,	,,	,,	*wi*	,, *wipe*	,,	*υἱός*

Besides these there are the so-called "improper" diphthongs formed by the union of the long vowels ᾱ, η, ω, with ι, the ι being written underneath thus, ᾳ, ῃ, ῳ, therefore being called "iota subscript." With capitals, however, it is written out in the line, thus ᾍδης becomes Ἅιδης. All diphthongs are long, that is, they receive stress in pronunciation.

A syllable may be long by *nature* or by *position*. It is long by *nature* when it has a long vowel or diphthong, as in πολῑτεύω, λῡ́θη. It is long by *position* when the vowel is followed by two consonants (or a double consonant), as in λέμμα, λέξις.

Consonants

The consonants may be classified according to this mode of production as labials, palatals, or linguals; or into the two classes, mutes or silent consonants, comprising such as can be sounded only in combination with a vowel, and semi-vowels. Thus we get the following grouping of nine mutes:—

	Smooth	*Middle*	*Rough or aspirated*
Labials	π	β	φ
Palatals	κ	γ	χ
Linguals	τ	δ	θ

The semi-vowels comprise the labial μ, and the linguals λ, ν, ρ, and σ, and are also, with the exception of σ, called liquids; μ, ν, and γ, when they have the sound of *ng* before palatals, are classed as nasals. There are three double consonants—ξ composed of κ and σ, ψ composed of π and σ, and ζ of σ and δ or δ and σ.

Except in the proclitics ἐκ and οὐκ or οὐχ, the only consonants occurring at the end of Greek words are ν, ρ, and ς (or the double consonants ξ and χ containing ς). In word formation other consonants left at the end are dropped.

Breathings

You will already have noticed that every vowel or diphthong beginning a word has above it one of two marks, the rough breathing (῾) or the smooth breathing (᾽). The former indicates that the vowel sound is aspirated, being equivalent to our *h*, the smooth breathing that it is not aspirated, thus ἑξ (hex), *six*, ἐξ (ex), *out of*. The rough breathing is always placed over initial ρ or υ, as in ῥεῦμα, *flow, rheum*, and ὕπνος, *sleep*. In diphthongs the breathings are put over the second vowel, as in αὖθις, εὕρηκα, or υἱός. They go to the left of capitals, as in Ἅιδης.

Accents *

You will also have noticed other marks called accents, analogous to those used in French and also to those used for indicating the stress in prosody. There are three of these accents, the acute (´), the grave (`), and the circumflex (^).

(1) The acute accent (´) is placed over one of the last three syllables of a word, as in *υἱός, αἰτία, εὕρηκα.*

(2) The grave accent (`) is placed only over final syllables, as in *ἀπὸ.*

(3) The circumflex (^) is placed only over syllables long by nature; whence it follows that it can be placed only over one of the two last syllables, as in *οἶνος, σκιᾶς.*

A word with the acute on the last syllable is called *oxytone* or sharp-toned.

A word with the acute on the last syllable but one or penultimate is called paroxytone.

A word with the acute on the last but two or antepenultimate is called proparoxytone.

A word with the circumflex on the last syllable is called perispomenon.

A word with the circumflex on the penultimate is called properispomenon.

A word with no accent on the last syllable is called barytone.

Punctuation Marks.—The comma and the period are employed in Greek as in English. The colon is one dot placed above the line as Εὖ ἔλεξας· πάντες γὰρ ὡμολόγησαν. The note of interrogation is our semicolon, τίς ταῦτα ἐποίησεν;

Preliminary Instruction in the Verb

First and most indispensable are the parts of the verb εἶναι, *to be*: these are as follows:—

εἰμί, I am.	*εἶ, thou art.*	*ἴσθι, be thou.*
ἐστί, he, she, or it is.	*ἦν, he, she, or it was.*	*ἔστω, let him be.*
εἰσί, they are.	*ἦσαν, they were.*	*ἔστε, be ye.*

Observe that in compliance with the Greek sense of euphony, ἐστί and εἰσί become ἐστίν and εἰσίν before a word beginning with a vowel.

The active and passive voices are differentiated in Greek by means of inflexion, thus:—

Active, *τύπτω, I strike;* passive, *τύπτομαι, I am struck.*

The Greek in addition has a third voice, called the middle voice, which has a reflexive sense, denoting an action reflected, or turned back,

Note on pronunciation:—The pronunciation given above and elsewhere is merely conventional English pronunciation.

* This section is placed here in order to furnish the student with an explanation of these marks, which will otherwise puzzle him and perhaps be a stumbling-block. He may postpone learning the principles of accentuation to any stage he chooses, and should certainly not try to assimilate it all at once. Nevertheless, he will find the effort required by no means labour thrown away.

upon the agent. In the present tense this voice does not differ in form from the passive, thus τύπτομαι in the middle voice means *I beat myself.*

The following are the forms likely to be required at present of a typical verb, βουλεύω, *I advise* :—

INDICATIVE MOOD.

	Present Active.	*Present Passive.*
Sing. 1.	βουλεύ-ω, *I advise.*	βουλεύ-ομαι, *I am advised.*
2.	βουλεύ-εις, *thou advisest.*	βουλεύ-ῃ or -ει, *thou art advised.*
3.	βουλεύ-ει, *he advises.*	βουλεύ-εται, *he is advised.*
Plur. 1.	βουλεύ-ομεν, *we advise.*	βουλευ-όμεθα, *we are advised.*
2.	βουλεύ-ετε, *you advise.*	βουλεύ-εσθε, *you are advised.*
3.	βουλεύ-ουσι (ν), *they advise.*	βουλεύ-ονται, *they are advised.*

IMPERATIVE MOOD.

Sing. 1.	βούλευ-ε, *advise thou.*	βουλεύ-ου, *be thou advised.*
Plur. 2.	βουλεύ-ετε, *advise ye.*	βουλεύ-εσθε, *be ye advised.*

INFINITIVE MOOD.

βουλεύ-ειν, *to advise.*	βουλεύ-εσθαι, *to be advised.*

The meaning of the middle voice is sometimes rendered by another word than that used for the active, thus, instead of *I advise myself*, we should say *I consider* or *I take advice.*

Inflexion

If you have studied Latin you will appreciate the significance of the statement that Greek is an inflected language. Inflexion is alteration of the form of a word, especially in the termination, giving it a different meaning or a special relation to other words in the sentence. Inflexion embraces the declension of nouns, pronouns, and adjectives and the conjugation of verbs. To a base are added endings representing the various limitations of person, number and tense, etc. In the same way, in nouns, pronouns, and adjectives, endings representing number, gender and case are added to the fundamental part called the stem.

There are three genders in Greek, as in Latin, masculine, feminine, and neuter. The masculine and feminine genders do not always correspond to the male and female sex, nor the neuter gender to inanimate things, although it is usually so. As a general rule, the names of male beings, of winds, months, and most rivers, are masculine; of female beings, of trees, lands, islands, and most cities, feminine, together with abstract nouns denoting qualities, conditions, etc.; and most diminutive nouns, names of fruits, of letters of the alphabet, the infinitives, and indeclinable nouns are neuter. Nouns like Θεός, *god* or *goddess*, which may be either masculine or feminine, are called common.

In Greek Grammar it is usual to employ the definite article ὁ, ἡ, τό, *the*, to indicate the gender; ὁ being masculine, ἡ feminine, and τό neuter; thus ὁ ἀνήρ, *the man*; ἡ γυνή, *the woman*; τὸ ἔργον, *the work*; ὁ or ἡ θεός, *the god* or *goddess.*

Besides singular and plural, as in English and most other languages, Greek has a third number, the dual. If a noun denotes one object it is in the singular number, as λόγος, *a word*; if more than one usually plural, as λόγοι, *words.* The dual denotes two objects, as λόγω, *two words.* It is, however, little used, except of pairs of things, as the two hands or the two eyes.

There are five cases, nominative, genitive, dative, accusative, and vocative, which have much the same meaning as those in Latin. But Greek has no ablative, its functions being discharged partly by the dative and partly by the genitive. The nominative is the case of the subject, as ὁ πατὴρ γράφει, *the father writes*; the genitive, the case indicative of origin, as τοῦ πατρός, *of the father* or *father's*; the dative, the case of the indirect object, as τῷ πατρί, *to* or *for the father*; the accusative, the case of the direct object, as ὁ υἱὸς τὸν πατέρα ἀγαπᾷ, *the son loves the father*; the vocative, that of invocation, as πατέρ, *O father.* The nominative and vocative are called direct cases, the others oblique cases.

In the plural the nominative and vocative have the same form. In the neuter gender, the nominative, accusative and vocative are alike in singular, plural and dual. The dual has only two case-endings, one for the nominative, accusative and vocative, the other for the genitive and dative.

THE DEFINITE ARTICLE, ὁ, ἡ, τό, *the.*

Singular.

	Mas.	*Fem.*	*Neut.*	*English.*
Nom.	ὁ	ἡ	τό	*the.*
Gen.	τοῦ	τῆς	τοῦ	*of the.*
Dat.	τῷ	τῇ	τῷ	*to* or *by the.*
Acc.	τόν	τήν	τό	*the.*

Plural.

Nom.	οἱ	αἱ	τά	*the.*
Gen.	τῶν	τῶν	τῶν	*of the.*
Dat.	τοῖς	ταῖς	τοῖς	*to* or *by the.*
Acc.	τούς	τάς	τά	*the.*

Dual.

Nom. Acc.	τώ	(τά)	τώ	*the.*
Gen. Dat.	τοῖν	(ταῖν)	τοῖν	*of* or *to the.*

Learn vertically.

There is no form for the vocative. The feminine forms in the dual, τά and ταῖν, are seldom used, especially the former, τώ and τοῖν being usually employed in all genders.

The definite article agrees with its noun in gender, number and case, as ἡ χώρα, *the land*; ὁ πολίτης, *the citizen.*

The possessive genitive is often inserted between the article and the substantive on which the genitive is dependent, as in ἡ Δήμητρος θυγάτηρ, *the daughter of Demeter*; ἡ τοῦ ποταμοῦ ὁδός, *the course of the river.*

E. A. B.

Australia, including Papua and Tasmania, is larger than the U.S.A., having an area of nearly 3,000,000 sq. miles. The most remarkable physical feature of the country is the great central desert, which has cost many an explorer his life.

Continued from page 38.

GEOGRAPHY:

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AUSTRALASIA.—I

One of the most popular conceptions of Australia and of Australasia in general is that it is a continent "down under," where most things are reversed, from the European point of view; where, for instance, the swans are black, and animals live such as the platypus, which has a mole's body, webbed feet and a duck's beak.

It is perfectly true that there is much in the fauna and flora of Australasia that differs very widely from anything that is met with in the remaining continents. But to expect complete originality in all such matters is decidedly to ask too much of a continent, and in this respect it will be seen that Australasia, interesting continent though it is, fails to fulfil the requirements!

Principal Features

It will be as well to deal first of all with the continent of Australia, giving the secondary place, as its area demands, to the smaller islands of New Zealand and the remaining groups. The total area of Australia, including Tasmania and Papua, amounts to the enormous figure of 2,974,600 square miles. It is thus almost 4,000 square miles greater in extent than the United States of America. Although as a continent its build is sufficiently compact, its most northerly point nearly reaches the latitude of 10° S., while the lowest point of Tasmania in the south stretches almost to latitude 44° S.

Perhaps the simplest method of reviewing some of the principal features of Australia will be to take the main geographical divisions one by one. Going from east to west, these are: the Eastern Highlands, the Murray Basin, the Great Artesian Basin, the Temperate Region, the Desert Region, and the Tropical Region.

The Eastern Highlands extend from the south-eastern point of the continent (and, properly speaking, include the Island of Tasmania) along the entire eastern coast, occupying a comparatively narrow strip to as far north as Cape York.

The lowlands of the Murray Basin extend southward from a little below latitude 30° S. to the coast, occupying the territory to the west of the southern part of the Eastern Highlands. A narrow strip of the Great Artesian Basin extends to the coast to the west of the Murray Darling Basin, where it is broken into by the South Australian Highlands, and then, broadening in the central latitudes of the continent, it stretches northwards to the Gulf of Carpentaria, narrowing again in area as it approaches the northern shore.

These three regions constitute, roughly, the eastern half of the continent. The three remaining geographical divisions lie parallel with each other, stretching across their half of the continent from east to west. Beginning at the south, these are the Temperate Region, a somewhat narrow strip which covers the entire western half of the southern coast, and which extends practically as far as Steep Point on the west coast. To the north of this is the Desert Region, which continues, roughly, to the Tropic of Capricorn, while to the north of this again is the Tropical Region, which includes the remainder of the continent to the western and northern coasts.

Coast Line

The Australian coast is not very much indented, and with the exception of the great Gulf of Carpentaria in the north, and the Australian Bight in the south, there are no inlets of primary importance from the geographical point of view. The principal indentations are on the north-west and the south-east coast, and on both of these shores these are numerous.

One of the most notable of the Australian natural features is the great central desert. The conditions of large areas of this are of such a nature that explorers attempting

to brave its terrible climate have found their finger-nails as brittle as glass, while the tube of the thermometer would burst, and Sturt reported that "the ink dried on the pen, human hair ceased to grow." This desert has cost the lives of more than one of the exploring parties that have attempted to cross it, among the most notable names of these explorers, by the way, being those of Burke, Wills, and Stuart.

Mountains

The highest mountain of the Eastern Highlands is Mount Kosciusco, a summit of the Australian Alps in New South Wales, and this mountain, it may be said, is the loftiest in the continent. Other important ranges, apart from the great eastern chain of mountains, are the Flinders Range in South Australia; the McDonnell, to the north of this, sheltering one of the few pastoral districts in the centre of the continent; the Hamersley Range in Western Australia, which in Mount Bruce rises to an altitude of four thousand feet; and the King Leopold Range in the north-west of the same territory.

The Murray River is responsible for the drainage of practically the entire south-eastern portion of the continent. This stream is the most important in Australia, and is notable for the fact that its waters are the only ones in Australia that do not tend to dry up in the seasons of drought. The chief tributary of the Murray, the Darling, is considerably longer than the main river. Two other of its affluents—all of which, it may be said, flow in from the north—are the Murrumbidgee and the Lachlan. There are now extensive plans on foot to store the waters of parts of this system with a view to assisting irrigation.

Rivers and Lakes

In Western Australia the Swan River, although very short, is important from the point of view of navigation, and in this respect it is of great service to the city of Perth. Crossing the Tropic of Capricorn on this coast is the Ashburton River, and to the north of this again are two navigable streams, the Victoria and the Fitzroy. The rivers which flow into the Gulf of Carpentaria are the Mitchell, Flinders, and Roper. The last enters the sea from the west coast of the great gulf, and is of great value for

navigation. In the desert waste of the centre of the continent are many streams which, owing to the nature of the country, flow somewhat aimlessly, and eventually lose themselves in the sand. In New South Wales occupiers of land may petition the State for the supply of an artesian well and distributing channels, paying a small annual charge for the service.

Although Australia is provided with some extensive sheets of salt water that in times of drought develop into mere waterless expanses of glittering salt, it cannot be said to possess any true lakes that are worthy of the name.

Salt Lagoons

The majority of the salt lagoons are in the southern districts of South Australia, and the largest are Lakes Eyre, Torrens, and Gairdner. Further to the north is Lake Amadeus, while in Western Australia the principal are Lakes Austin and Barlee.

The climate of Australia is chiefly notable for its peculiarities connected with rainfall and the lack of it. Save for an arid stretch where the desert penetrates to the central western coast, it may be said that the great Australian Desert of the interior is surrounded by a fringe of watered territory. This is widest in the north, of moderate extent in the east, at its narrowest in the south, and, as has been said, falls away altogether in the central west.

An Arid Centre

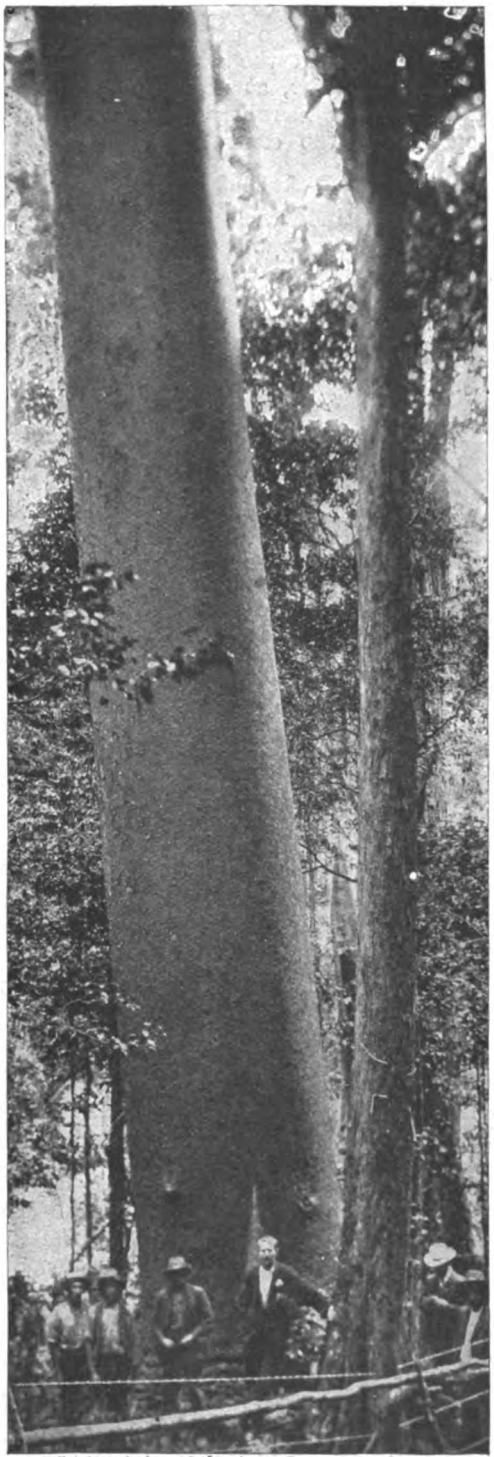
Tasmania is in the well-watered zone, and in one district here, as well as in one of Queensland, the rainfall in the course of the year exceeds one hundred inches. In the arid and sandy centre of the continent, on the other hand, the average of such utterly insignificant rainfall as can be registered does not seem to exceed one-fifth of an inch in the course of the entire year.

It is almost unnecessary to explain that, speaking generally, the greatest heat obtains in the tropical north and arid centre, and that the mildest climate is in the south and in the island of Tasmania, the climate of which latter place suggests a rather sunnier and warmer England. But these more rigid rules of atmosphere are locally tempered by the south-east Trade winds which blow in from the Pacific and by the monsoons which sweep in from the north.

By permission of the Agent-General for New South Wales.

IRRIGATING LUCERNE.

A vegetation which thrives in the barren wastes of Australia and which under the gentle influence of water proves itself a very valuable fodder.



By permission of the Agent-General for Queensland.

KAURI PINE.

An immense specimen of one of the many varieties of resiniferous trees that flourish in the forests of Australasia.

The aborigines of Australia afford a peculiarly interesting study to those concerned in anthropology. From the mere numerical point of view they are of not much consequence, it is true. Never numerous even in the days before the advent of the white man, their total population is at the present time estimated not to exceed one hundred thousand. This estimate, it must be said, is a very rough one, for in various parts of the continent the tribes live in a perfectly savage state, and, owing to their remoteness, the computing of their numbers is largely a matter of guesswork.

A theory has long prevailed that these aborigines of Australia were among the lowest and least intelligent types of humanity. But there does not seem to be any foundation in actual fact for this, and, indeed, it is now maintained that, so far as intelligence is concerned, the Australian aboriginal is the superior of the average negro.

Australian Aborigines

Physically, it must be admitted that the Australian blacks have been endowed with very few attractive features. They are unusually hirsute, possess the broad, squat nose of the negro, but at the same time have prominent cheekbones and a high forehead. The present theory of their origin is that in prehistoric times they came to Australia from India by way of New Guinea.

Much light has of recent years been shed on the peculiar customs of these people, the Horn expedition and Messrs. Spencer and Gillen having been largely instrumental in this. Some of the sacred ceremonies and corroborees are most quaint, though their actual significance is seldom easy to follow.

Elaborate preparations are wont to be made for these, and the performers decorate themselves with their own species of finery, painting their bodies in designs, and covering themselves with peculiar adornments, and their heads with species of helmets. Opossum and human hair, red and yellow ochre, feathers, tassels made from the tail tips of the bandicoot, bits of gypsum, and various other implements of crude finery play their part in these queer ceremonies.

The favourite weapons of these curious people are the spear and the boomerang. The blade of the former is usually made of hard wood. The latter is a curved wooden weapon, a couple of feet or so in length, which, when flung by an adept, will circle round in the air and return to fall near the feet of the thrower, should it have missed the object at which it was flung.

By permission of the Agent General for Queensland.

A NATIVE CAMP IN QUEENSLAND.

To the anthropologist, the aborigines of Australia afford a particularly interesting study. Never numerous—even before the advent of the white man—it is estimated that there are not now 100,000 of them in the continent.

The great majority of the Australian fauna belong to the primitive groups of the monotremes, and the marsupials. Among the exceptions to this rule are some species of rats, mice, bats, and the dingo. Some of the characteristic creatures of the continent are the kangaroo, the wallaby, and, of course, the platypus that has already been referred to. Other native animals are the opossum, tailless bear, wombat, ant-eater, bandicoot, spiny ant-eater, flying phalanger, and marsupial mice and moles. The rabbit, introduced from England, has now increased to such an extent as to constitute a pest.

The birds are far more varied. Perhaps the most characteristic of all the species are the black swan, emu, cassowary, and the laughing jackass, a bird of the kingfisher family.

Australian Birds

The magnificent bird of paradise is met with in the north, and others of the more brilliant species include cockatoos, lyre-birds, honeysuckers and kingfishers. There are also wrens, pigeons, wild geese and ducks, and various other kinds.

Among the reptiles of the tropical north is the crocodile, the only large creature of prey that the continent possesses. Other reptiles are iguanas, lizards, geckos, turtles, tortoises, and numerous varieties of frogs and toads, including the deep-noted bull-frog. Numerous species of snakes exist, the bite of five kinds being fatal. The black snake is one of the most common, and this sometimes attains to a length of eight feet.

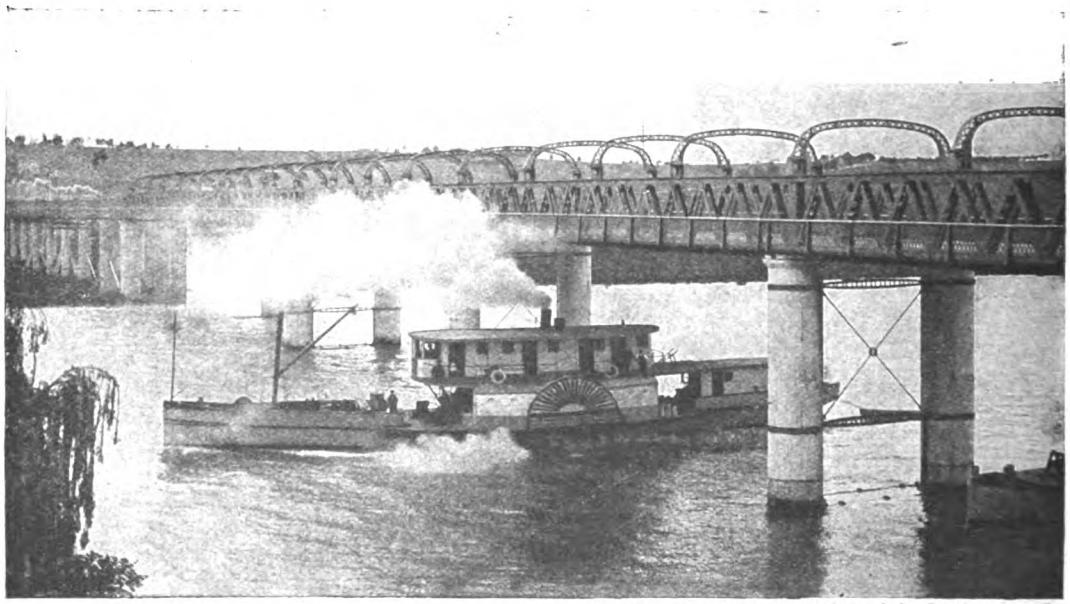
The Australian forests are very largely composed of the eucalyptus, of which more than three hundred varieties exist.

Eucalyptus Trees

The aspect of this vegetation, which is of a uniform olive-green tint, is monotonous. The eucalyptus, however, is valuable for numerous purposes, including the oil which is now extracted in large quantities from the leaves. Eucalyptus essence is used as a disinfectant or preventive medicine to ward off colds, a use with which everyone is familiar.

In many parts of the continent a low scrub characterises the landscape, and in the tropical north some real jungle occurs. Other Australian growths are the wattle, a species of acacia, with its golden blossom, the handsome waratah, the tea tree, and the boronia. There are also beeches, conifers, and tree-ferns. The jarrah wood, being very hard and durable timber, is well suited for railway sleepers and purposes of a similar nature.

W. H. K.



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ON THE MURRAY RIVER IN SOUTH AUSTRALIA.

This river is responsible for the drainage of practically the entire south-eastern portion of the continent; and—almost alone among the rivers of Australia—it continues to be a river in seasons of drought.

Continued from page 44.

MATHEMATICS:

Contributor: — ARITHMETIC, ALGEBRA, GEOMETRY, CO-ORDINATE GEOMETRY, TRIGONOMETRY, MECHANICS, MENSURATION, ETC.

(M. A. Lewenz, M.A.[Lond.]).

ALGEBRA.—XXV

147. Convergency and Divergency of Series.

A series is a succession of quantities which are formed in order according to a certain law. If the series terminates after a certain number of terms it is clearly finite, but if there is an unending succession of terms it is called infinite. We saw that in a G. P. whenever the common ratio is < 1, the sum of n terms does not increase without limit as n increases without limit, but that as n increases without limit the sum approaches more and more nearly to a fixed finite quantity.

If we call the sum of n terms of a series S_n, and if as n increases without limit S_n approaches more and more nearly to a fixed finite quantity, that quantity is called the sum of the infinite series.

Whenever the sum of the first n terms of a series tends to a finite limit S, so that by increasing n sufficiently the sum may be made to differ from s by any assignable quantity, however small that quantity may be, the series is said to be **convergent** and S is its sum.

When the first n terms of a series increases without limit as n increases without limit, the series is said to be **divergent.**

When the sum of the first n terms of a series does not increase without limit, but does not approach any determinate limit, the series is neither convergent nor divergent, but is said to be **neutral or indeterminate** or the series is said to **oscillate.**

Thus $3 - 2 - 1 + 3 - 2 - 1 + 3 - 2 - 1 + \ldots + \ldots$ oscillates, for if $n = 3r$, $S = 0$; if $n = 3r + 1$, $S = 3$; if $n = 3r + 2$, $S = 1$.

In any series, if from a fixed term onward, all the terms are of the same sign, it cannot be neutral, but must be either convergent or divergent. For if, as n increases, the sum does not increase without limit, there must be some finite limit which the sum can never exceed, but to which it approaches more and more nearly.

If each term of a series be finite, and all the terms have the same sign, the series must be divergent. For suppose each term be not $< \alpha$, then the sum of n terms cannot be $< n\alpha$, and by making n large enough, we can make $n\alpha >$ any quantity however great.

We shall denote the successive terms of a series by $u_1, u_2, u_3, \ldots u_n \ldots$

In order to know the series we must know the general term, i.e. we must know how to express u_n when n is known.

Let $U_n = u_1 + u_2 + u_3 + \ldots\ldots + u_n$

Let $U_\infty = u_1 + u_2 + u_3 + \ldots\ldots + u_n + u_{n+1} + \ldots\ldots$ to ∞.

148. In order that the series $u_1 + u_2 + \ldots\ldots + u_n + \ldots\ldots$ may be convergent, it is by definition necessary and sufficient that the sum U_n should approach indefinitely near to some finite limit S as n is increased without limit.

If we take a very small quantity ϵ, however small we take it, we must be able to take n so large that $U_n - S < \epsilon$ for all values of n greater than the one selected.

i.e. if $U_r - S < \epsilon$

and $U_{r+1} - S \not< \epsilon$, the series would not be convergent

Now in any series, $U_{n+1} - U_n = u_{n+1}$ . . . (*a*)

$U_{n+2} - U_n = u_{n+1} + u_{n+2} \cdot \cdot \cdot \cdot \cdot \cdot \cdot$

$U_\infty - U_n = u_{n+1} + u_{n+2} + \ldots\ldots$ to ∞.

Hence in order that a series may be convergent, it follows from these that u_{n+1} must diminish without limit as n increases without limit. This follows from (*a*) for as we increase n, U_n and U_{n+1} both approach S, and their difference approaches 0.

Also both U_n and U_{n+2} approach S as n increases without limit, and their difference $u_{n+1} + u_{n+2}$ approaches 0.

Similarly $n_{n+1} + n_{n+2} + n_{n+3} + \ldots\ldots$ must approach 0 as n increases without limit,

i.e. $u_{n+1} + u_{n+2} + u_{n+3} + \ldots\ldots + u_{n+r}$ approaches 0 as n increases without limit, whatever integer r may be,

i.e. $U_{n+r} - U_n$ approaches 0.

Hence in order that a series may be **convergent,** *the* $(n + 1)$*th term must decrease without limit as* n *increases without limit, and also the sum of any number of terms beginning at the* $(n + 1)$*th must become* $<$ *any assignable quantity however small, when* n *increases without limit.*

Note that the first condition may be satisfied without the second.

Take the H. P. $1 + \frac{1}{2} + \frac{1}{3} + \ldots + \frac{1}{n} + \ldots\ldots$

$u_{n+1} = \frac{1}{n+1}$ and this diminishes without limit as n increases without limit.

$u_{n+1} + u_{n+2} + u_{n+3} + \ldots + u_{n+r} = \frac{1}{n+1} + \frac{1}{n+2} + \frac{1}{n+3} + \ldots + \frac{1}{n+r}$

Now suppose $r = n$, then

$u_{n+1} + u_{n+2} + \ldots u_{2n} = \frac{1}{n+1} + \frac{1}{n+2} + \ldots \frac{1}{2n}$

$> \frac{1}{2n} + \frac{1}{2n} + \ldots + \frac{1}{2n}$ (to n terms)

i.e. $> \frac{n}{2n}$, i.e. $> \frac{1}{2}$.

Here the second condition is not satisfied, and the series is not convergent.

149. We shall first consider series in which all the terms have the same sign, and we will take them as being all positive.

(i) *A series in which all terms are positive is convergent if all its terms are < the corresponding terms of a second series known to be convergent.*

Let $U = u_1 + u_2 + \ldots + u_n + \ldots$ be convergent

Let $V = v_1 + v_2 + \ldots + v_n + \ldots$

All terms in U and V are positive and $v_n < u_n$ for all values of n.

Then $v_1 + v_2 + \ldots + v_n < u_1 + u_2 + \ldots + u_n$.

Now as n increases without limit the right hand side is finite $\therefore$ the left hand side is finite. V is a series in which all terms are positive $\therefore$ V is not neutral but must be either convergent or divergent. But we have shown that the sum of n terms remains finite, however large n may be $\therefore$ the series is convergent.

Example :—

If $x > 0$, show that

$1 + x + \frac{x^2}{2!} + \frac{x^3}{3!} + \ldots + \frac{x^4}{n!} + \ldots$ is convergent.

$T_{n+1} = \frac{x^n}{n!}$ $\quad T_n = \frac{x^{n-1}}{(n-1)!}$

$\therefore \frac{T_{n+1}}{T_n} = \frac{x}{n}$.

Hence if you take $n > x$, $T_{n+1} < T_n$; $T_{n+2} < T_{n+1} \ldots$

i.e. the terms diminish as soon as $n > x$

Now $T_{n+1} + T_{n+2} + T_{n+3} + \ldots$

$= \frac{x^n}{n!} + \frac{x^{n+1}}{(n+1)!} + \frac{x^{n+2}}{(n+2)!} + \ldots$

$= \frac{x^n}{n!}\left[1 + \frac{x}{n+1} + \frac{x}{n+1} \cdot \frac{x}{n+2} + \frac{x}{n+1} \cdot \frac{x}{n+2} + \frac{x}{n+3} + \ldots\right]$

$< \frac{x^n}{n!}\left[1 + \frac{x}{n+1} + \left(\frac{x}{n+1}\right)^2 + \left(\frac{x}{n+1}\right)^3 + \ldots\right]$

Now the series in the last square brackets is a G. P. with common ratio < 1

$\therefore T_{n+1} + T_{n+2} + \ldots$ is convergent.

And if we add to these the finite sum $T_1 + T_2 + \ldots + T_n$ the whole series must be convergent.

(ii) *If the ratio of corresponding terms of two series be always finite, the series will both be convergent or both divergent.*

(The terms of both are supposed to have the same sign, so that neither can oscillate.)

Let the series be $U = u_1 + u_2 + u_3 + \ldots + u_n + \ldots$

and $V = v_1 + v_2 + v_3 + \ldots + v_n + \ldots$

the ratio $\frac{v_n}{u_n}$ is finite.

(1) Let U series be convergent.

$\because u_n$ and v_n are both positive $\therefore \frac{v_n}{u_n} > 0$

and as $\frac{v_n}{u_n}$ is finite, we may suppose $\frac{v_n}{u_n}$ lies between A and B, two fixed finite positive quantities.

Let $A < \frac{v_n}{u_n} < B$, then $\because u_n$ is positive

$A u_n < v_n < B u_n$

This is true for all values of n

$\therefore Au_1 < v_1 < Bu_1$

$Au_2 < v_2 < Bu_2$

$\ldots\ldots$

$Au_n < v_n < Bu_n$

Adding, $A(u_1 + u_2 + \ldots + u_n) < (v_1 + v_2 + \ldots + v_n) < B(u_1 + u_2 + \ldots + u_n)$

Since U series is convergent, $u_1 + u_2 + \ldots + u_n$ is always finite

$\therefore v_1 + v_2 + \ldots + v_n$ is included between two finite quantities

$\therefore$ V series is always finite, and as all its terms are positive, the V series is convergent.

(2) Next let U series be divergent. Then by taking n large enough we can make $u_1 + u_2 + \ldots + u_n >$ any number however large.

$\therefore v_1 + v_2 + \ldots + v_n$ can be made $>$ any number however large

$\therefore$ V series is divergent.

(iii) *A series is convergent if after any particular term, the ratio of each term to the preceding one is always < fixed quantity which itself is < 1.*

Let $U = u_1 + u_2 + \ldots + u_n + \ldots$

have all terms positive, and let $\frac{u_{n+1}}{u_n} < k < 1$ by some finite difference (so that this difference cannot be made $<$ than some finite quantity ϵ, however large n may be)

Then we have

$u_{n+1} < ku_n$

$u_{n+2} < ku_{n+1} < k^2 u_n$

$\ldots\ldots\ldots\ldots$

Now $u_2 < kn$

$u_3 < ku_1 < k^2 u_1$

$\therefore u_n < k^{n+1} u_1$

$\therefore u_1 + u_2 + \ldots + u_n + \ldots < n_1(1 + k + k^2 + \ldots + k^{n-1} + k^n + \ldots)$

Now the right-hand side is a G.P. with common ratio $K < 1$ by a finite difference

$\therefore u_1 + u_2 + \ldots + u_n + \ldots < \frac{u_1}{1-k}$

$\therefore u_1 + u_2 + \ldots + u_n + \ldots$ is finite however large n may be

and $\because$ all these terms have the same sign

$\therefore$ series U does not oscillate, but is either convergent or divergent.

But it is not divergent $\because$ the sum of the terms $u_1 + u_2 + u_3 + \ldots + u_n$ is finite, however large n may be.

$\therefore$ the series is convergent.

(iv) *A series is divergent if after any particular term the ratio of each term to the preceding one* $= 1$ *or* > 1.

We assume all terms to be positive

Suppose the particular term is u_r

Then $u_{r+1} \overset{=}{>} u_r$

$u_{r+2} \overset{=}{>} u_{r+1} \overset{=}{>} u_r$

. . . . . .

$u_{r+n} \overset{=}{>} u_r$

$\therefore u_{r+1} + u_{r+2} + \ldots\ldots + u_{r+n} \overset{=}{>} nu_r$

and this increases without limit as n increases without limit

$\therefore$ the series is divergent.

Example:

Consider the series $1^2 + 2^2x + 3^2x^2 + \ldots r^2x^{r-1} + \ldots$

$\left.\begin{matrix} T_{r+1} = (r+1)^2 x^r \\ T_r = rx^{r-1} \end{matrix}\right\} \therefore \frac{T_{r+1}}{T_r} = \left(\frac{r+1}{r}\right)^2 x$

$= \left(1 + \frac{1}{r}\right)^2 x$

If $x \overset{>}{=} 1$, the ratio $\frac{T_{r+1}}{T_r} > 1$, the terms increase and the series is divergent.

If $x < 1$, $\frac{T_{r+1}}{T_r}$ is the product of two factors, one of which $\left(1 + \frac{1}{r}\right)$ is > 1, the other $x < 1$

By taking r large enough 1st factor can be made as nearly equal to 1 as we like. Take some quantity k such that $x < k < 1$ and k differs from 1 by a finite difference. We can show that it is possible to find a term in the series such that for all terms after it, the ratio of any term to the preceding one $< k$.

$\frac{T_{r+1}}{T_r} = \left(1 + \frac{1}{r}\right)^2 x$. We must find a value of r such that $\left(1 + \frac{1}{r}\right)^2 x < k$, i.e. $\left(1 + \frac{1}{r}\right)^2 < \frac{k}{x}$,

i.e. $1 + \frac{1}{r} < \frac{+\sqrt{k}}{+\sqrt{x}}$ i.e. $\frac{1}{r} < \frac{\sqrt{k} - \sqrt{x}}{\sqrt{x}}$

The numerator $\sqrt{k} - \sqrt{x}$ is positive $\because k > x$

$\therefore$ we must choose r so that $r > \frac{\sqrt{x}}{\sqrt{k} - \sqrt{x}}$

and having thus found r, we see that the series is convergent.

This example illustrates Theorems III and IV.

Exercise 36

(1) Show that the series $\frac{1}{1.2} + \frac{1}{3.4} + \frac{1}{5.6} + \ldots + \frac{1}{(2n+1)(2n+2)} + \ldots\ldots$ is convergent.

(2) Show that the series $\frac{1}{3} + \frac{1.3}{3.6} + \frac{1.3.5}{3.6.9} + \ldots + \frac{1.3.5 \ldots (2n-1)}{3.6.9 \ldots 3n} + \ldots$ is convergent.

(3) Show that the series $\frac{1}{x} + \frac{1}{x+1} + \frac{1}{x+2} + \ldots$ is divergent.

(4) Show that the series $\frac{1}{1+x} + \frac{1}{1+x^2} + \frac{1}{1+x^3} + \ldots$ is convergent if $x > 1$, divergent if $x < 1$.

Key to Exercise 34

(1) $a^7 - 7a^6x + 21a^5x^2 - 35a^4x^3 + 35a^3x^4 - 21a^2x^5 + 7ax^6 - x^7$.

(2) $32a^5 - 80a^4x + 80a^3x^2 - 40a^2x^3 + 10ax^4 - x^5$.

(3) $1 - 4x^2 + 6x^4 - 4x^6 + x^8$.

(4) $x^{10} + 10x^8y^3 + 40x^6y^6 + 80x^4y^9 + 80x^2y^{12} + 32y^{15}$.

(5) $16x^4 - 16x^3y + 6x^2y^2 + xy^3 + \frac{y^4}{16}$.

(6) $a^7 - \frac{21a^6}{b} + \frac{189a^5}{b^2} - \frac{945a^4}{b^3} + \frac{2835a^3}{b^4} - \frac{5103a^2}{b^5} + \frac{5103a}{b^6} - \frac{2187}{b^7}$. (7) $-448y^5$. (8) $924b^{20}$.

(9) $2^r \times \frac{n!}{r!\,(n-r)!} a^{n-r}b^r$. (10) $(-1)^r \times 2^{n-r} \times 3^r \times \frac{n!}{r!\,(n-r)!} a^{n-r}b^r$. (11) $20x^3$. (12) $\frac{24!}{12!\,12!} a^{12}b^{12}$.

Key to Exercise 35

(3) 6. (4) 6, 24. (5) 312. (6) 0.

M. A. L.

MECHANICS.—III

17. We shall now obtain a few general formulæ for the motion of bodies under the action of gravity.

(*a*) **Distance fallen in the nth second** after starting from rest.

This = difference between total distance fallen in n seconds and in $(n-1)$ seconds

$= \frac{1}{2}gn^2 - \frac{1}{2}g(n-1)^2$

$= \frac{1}{2}g\{n^2 - (n-1)^2\} = \frac{1}{2}g(2n-1)$

(*b*) **Time taken in dropping from a height** h.

Here the distance $s = h$

$\therefore h = \frac{1}{2}gt^2 \therefore t = \sqrt{\frac{2h}{g}}$

Also the velocity acquired, v is given by $v^2 = 2gh \therefore v = \sqrt{2gh}$

(*c*) **For bodies projected downwards** with an initial velocity v_0 we have the following relations

Final velocity $v = v_0 + gt$

Distance $s = v_0t + \frac{1}{2}gt^2$

and $v^2 = v_0^2 + 2gs$

(*d*) **For bodies projected upwards** with an initial velocity v_0, we have

$v = v_0 - gt$

$s = v_0t - \frac{1}{2}gt^2$

$v^2 = v_0^2 - 2gs$.

(*e*) **Time during which a body rises.**
The body ceases to rise when $v = 0$

hence we have $0 = v_0 - gt \therefore t = \frac{v_0}{g}$

(*f*) **Greatest height to which body rises.**
The height is greatest at the moment when the body ceases to rise, i.e. when $v = 0$

Hence we have $0 = v_0^2 - 2gs \therefore s = \frac{v_0^2}{2g}$

(*g*) **Time taken to rise and fall to starting point.**
Since the body returns to starting point the distance travelled upwards is counterbalanced by the distance fallen. Hence $s = 0$, and we have

$0 = v_0 t - \frac{1}{2}gt^2$

$\therefore t\,(v_0 - \frac{1}{2}gt) = 0$

and rejecting the solution $t = 0$ which applies only when the body does not move, we have

$v_0 - \frac{1}{2}gt = 0 \therefore t = \frac{2v_0}{g}$

Comparing this with the formula in (*e*) we see that the body rises for half the time it takes to rise and fall, i.e. it takes the same time to rise as to fall.

This is only to be expected when we consider that the acceleration is uniform.

From the formula $v^2 = v_0^2 - 2gh$ (where h = height), we get

$v = \pm \sqrt{v_0^2 - 2gh}$,

which shows that the velocities in passing any point, whether in the rise or in the fall, have the same numerical value, but are of opposite signs.

18. **Relative Velocity.**—Supposing a man is travelling on a train and walks along the corridor, then the velocity with which he walks is his velocity relative to the velocity of the train, but the actual velocity with which he moves with regard to the earth is compounded of the velocity of the train and his velocity relative to the train. Thus if he walks in the direction in which the train is travelling, his actual velocity is (velocity of train) + (velocity with which he walks). If, on the other hand, he walks in the direction opposite to that in which the train travels, then his actual velocity is (velocity of train) — (velocity with which he walks). Again, if one train pass another, the relative velocity of the first to the second is the *algebraic* difference of their actual velocities. Suppose both trains to be travelling in the same direction, one at 60 $\frac{\text{miles}}{\text{hour}}$ and the other at 20 $\frac{\text{miles}}{\text{hour}}$.

Then the relative velocity of the first to the second is $(60 - 20)\frac{\text{miles}}{\text{hour}} = 40\frac{\text{miles}}{\text{hour}}$.

And if they are travelling in opposite directions then the relative velocity of the first to the second is $\{60 - (-20)\}\frac{\text{miles}}{\text{hour}} = 80\frac{\text{miles}}{\text{hour}}$.

This we may illustrate by a diagram.

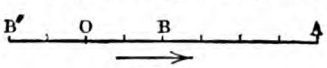


Fig. 4.

If we start from the point O, then O A represents the velocity of the first train = 60 miles per hour travelling in the direction of the arrow. If the second train travels in the same direction at 20 $\frac{\text{miles}}{\text{hour}}$, its velocity will be represented by O B, and the relative velocity of the first to the second will be represented by B A, the difference between O A and O B, i.e. 40 $\frac{\text{miles}}{\text{hour}}$. If the second train travels in the opposite direction to the arrow, then its velocity of — 20 $\frac{\text{miles}}{\text{hour}}$ will be represented by O B′, and the relative velocity of the first to the second will be represented by B′ A, the difference between O A and — O B′, i.e. 80 $\frac{\text{miles}}{\text{hour}}$.

19. **Composition of Velocities not in the same Straight Line.**
Supposing a man rows a boat across a river, which is flowing with a current of a certain velocity, at right angles to the current; he will not arrive at the farther bank at a point directly opposite to that from which he started, but at one lower down. The resultant motion will be compounded of the motion due to the current and the motion due to the man's rowing. Thus:

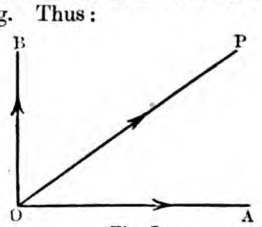


Fig. 5.

If he starts from O and drifted with the current he would in a certain number of seconds reach the point A. If he rowed straight across, unaffected by the current, he would in the same time reach B.

As a result of the two motions he actually reaches the point P.

O P is the resultant of the two motions O A and O B.

Now uniform velocities, accelerations, and (as we shall see later) forces have both magnitude and direction, and these two must be stated in order to specify the above completely.

They may be graphically represented by straight lines whose length is proportional to the magnitude, whose direction is the same as the specified direction, while the **sense** can be indicated by an arrow head.

Thus the line A B may be taken to represent a velocity of 10 $\frac{\text{ft.}}{\text{sec.}}$ in the direction of the line and in the sense of A to B, where $\frac{1}{10}$ of an inch represents a velocity of 1 $\frac{\text{ft.}}{\text{sec.}}$

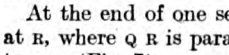


Fig. 6.

Now consider a body which is tending to move with a uniform velocity which would take it from O to P in one second, and also with a uniform velocity v^1 which would take it to Q in one second.

At the end of one second the body will be found at R, where Q R is parallel to O P and P R is parallel to O Q (Fig. 7).

O R represents the resultant velocity V in magnitude, sense and direction.

The above is called the parallelogram of velocities and may be stated in words thus:—

If a body tend to move with two uniform velocities represented in magnitude and direction by the two sides of a parallelogram drawn through a fixed point, then the resultant (or actual) velocity will be uniform and will be represented in magnitude and direction by the diagonal through that point.

In Fig. 7, since P R is equal and parallel to O Q it clearly represents the velocity v^1 as well as O Q

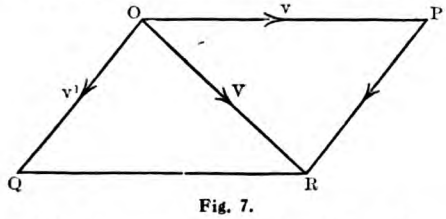


Fig. 7.

does. Hence we see that O P and P R have the resultant O R.

Thus we may draw first O P representing v in magnitude, sense and direction, then P R representing v^1 in magnitude sense, and direction, and by joining the extremities O and R we get the resultant velocity V.

This is called the triangle of velocities, and is sometimes a more convenient construction than the parallelogram.

20. If a body tend to move with two velocities represented by O P and P O, it will remain at rest, for P O = — O P and their algebraic sum is zero.

Now since in Fig. 7 velocities O P and P R have a resultant O R, it is clear that if there is a third component velocity R O (which is equal and opposite to O R), the body will remain at rest.

These three velocities, then, are represented in magnitude, direction and sense by the three sides of the triangle O P R taken in order.

Hence we get the **Triangle Law.**

If a body tend to move with three uniform velocities which can be represented by the three sides of a triangle taken in order, then the body remains at rest.

21. The Polygon of Velocities.

From the foregoing it will be clear that if a body tend to move simultaneously with several velocities v_1, v_2, v_3, v_4 . . . . . which can be represented in magnitude, direction and sense by the lines O A, O B, O C, O D . . .

and if A B^1 be drawn equal and parallel to A B

B^1 C^1 be drawn equal and parallel to O C

C^1 D^1 be drawn equal and parallel to O D

then O B^1, the diagonal of the parallelogram A O B B^1 is the resultant of O A and O B, and O C^1, the diagonal of the parallelogram O C C^1 B^1 is the resultant of O B^1 and O C

and therefore the resultant of O A, O B and O C; and O D^1, the diagonal of the parallelogram O D D^1 C is the resultant of O C^1 and O D and therefore of O A, O B, O C, O D.

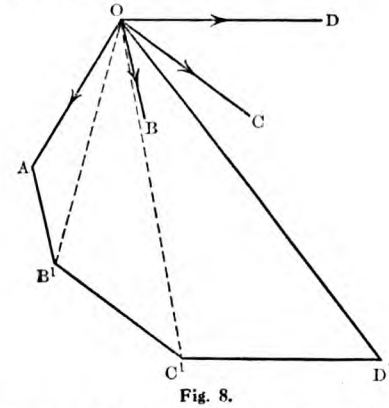


Fig. 8.

Thus we see that simultaneous velocities of v_1 v_2, v_3, v_4 would bring the body from O to D^1, and therefore if D^1 coincided with O, the body would remain at rest.

Hence we get the **Polygon Law.**

If a body tend to move with several uniform velocities which can be represented in magnitude, direction and sense by the sides of a closed polygon taken in order, then the body remains at rest; if the polygon representing the velocities be open (as in Fig. 8), the body will move with a resultant velocity represented by the line that closes the polygon.

22. To find the magnitude of the resultant of two velocities v_1 and v_2 which are in directions at right angles to one another.

Draw O X and O Y at right angles to one another.

Mark off O A containing v_1 units of length, and mark off O B containing v_2 units of length.

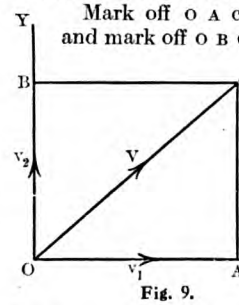


Fig. 9.

Then O A, O B represent the velocities v_1 and v_2.

Complete the parallelogram O A P B and join O P.

Then O P represents the resultant velocity V.

Since O A P is a right angled triangle

$OP^2 = OA^2 + AP^2$

but A P = O B $\therefore$ $OP^2 = OA^2 + OB^2$

$\therefore$ $V^2 = v_1^2 + v_2^2$

$\therefore$ resultant velocity $V = \sqrt{v_1^2 + v_2^2}$

23. Resolution of Velocities.

As the diagonal of a parallelogram, whose sides represent two velocities, represents the resultant velocity, so any velocity represented by a straight line may be resolved into component velocities represented by the sides of any parallelogram of which the straight line is a diagonal. It is clear that there is an infinite number of parallelograms

of which the straight line is a diagonal, the velocity therefore may be resolved into two components in an infinite number of ways which vary according to the inclination of the sides of the parallelogram to one another.

24. The most important cases are those in which the component velocities are at right angles and make angles of 45°, 30° and 60° with the given velocity:

CASE (i).—A velocity V is inclined at an angle of 45° to two given straight lines at right angles to each other. To resolve V into component velocities v_1 and v_2 along these two straight lines.

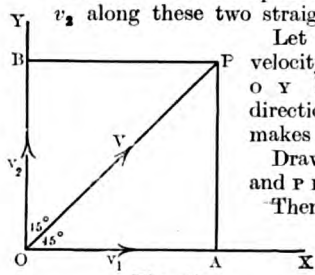


Fig. 10.

Let O P represent the velocity V and let O X and O Y be the two given directions with which O P makes angles of 45°.

Draw P A parallel to O Y and P B parallel to O X.

Then by the parallelogram of velocities O A and O B or A P represent velocities v_1 and v_2 whose resultant is V, i.e. O A and O B represent the required components.

Now $\angle$ A O P = 45° and $\angle$ A P O = 45°

$\therefore$ A O P is a right angled isosceles triangle

$\therefore$ O A^2 + A P^2 = O P^2

$\therefore$ 2 O A^2 = O P^2

$$\therefore\ 2v_1^2 = V^2\ \therefore\ v_1 = \frac{V}{\sqrt{2}} = \tfrac{1}{2}\sqrt{2}\,V$$

Similarly since O A = O B

$\therefore\ v_2 = \frac{1}{2}\sqrt{2}\,V$

Hence the required components are $\frac{1}{2}\sqrt{2}\,V$ along O X and $\frac{1}{2}\cdot\sqrt{2}\,V$ along O Y.

CASE (ii).—A velocity V is inclined at angles of 30° and 60° to two given straight lines at right angles to each other. To resolve V into component velocities v_1 and v_2 along these two straight lines.

Let O P represent the velocity V and let O X and O Y be the two given directions with which O P makes angles of 30° and 60°.

Draw P A parallel to O Y and P B parallel to O X.

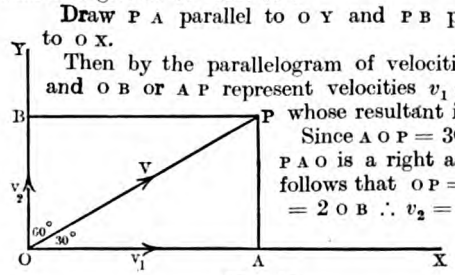


Fig. 11.

Then by the parallelogram of velocities O A and O B or A P represent velocities v_1 and v_2 whose resultant is V.

Since A O P = 30° and P A O is a right angle it follows that O P = 2 A P = 2 O B $\therefore\ v_2 = \frac{1}{2}V$

and O P^2 = O A^2 + A P^2 $\therefore$ O A^2 = O P^2 − A P^2 = O P^2 − $\frac{1}{4}$ O P^2 = $\frac{3}{4}$ O P^2

$$\therefore\ \text{O A} = v_1 = \frac{\sqrt{3}}{2}V.$$

Thus the components are $\frac{1}{2}\sqrt{3}\,V$ along O X and $\frac{1}{2}\,V$ along O Y.

All that has been said about the resolution of velocities applies equally to accelerations.

Example:—

A man on a train moving at 30 miles an hour wants to hit a tree 200 yards away in a line passing through the man at right angles to the direction of the train. If his bullet has a uniform velocity

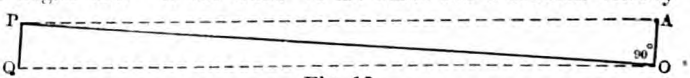


Fig. 12.

of 1,200 feet per second, how much to one side of the tree must he aim?

$30\ \frac{\text{miles}}{\text{hour}} = 44\ \frac{\text{ft}}{\text{sec.}}$ = vel. of train.

bullet travels 1,200 ft. per sec. and therefore bullet travels 200 yards in $\frac{1}{2}$ sec.

In $\frac{1}{2}$ sec. the train moves 22 ft. We therefore have the following diagram.

O P represents 200 yards

O A represents 22 ft., the distance moved by the train.

O P must be the resultant motion of O A and the direction in which the bullet is fired, i.e. O P is the diagonal of a parallelogram of which O A is one side.

Join A P and complete the parallelogram O A P Q.

The bullet must be fired in the direction O Q

i.e. the man must aim at Q.

Now P Q = O A = 22 ft.

Therefore the man must aim 22 ft. away from P in the direction opposite to that in which the train is moving.

Exercise 3

(1) What is the resultant velocity of two velocities at right angles to each other of (*a*) 4 $\frac{\text{ft.}}{\text{sec.}}$ and 3 $\frac{\text{ft.}}{\text{sec.}}$ (*b*) 2 $\frac{\text{ft.}}{\text{sec.}}$ and 5 $\frac{\text{ft.}}{\text{sec.}}$ (*c*) 20 $\frac{\text{miles}}{\text{hour}}$ and 20 $\frac{\text{ft.}}{\text{sec.}}$

(2) Resolve along two lines at right angles to each other a velocity of 30 $\frac{\text{ft.}}{\text{sec.}}$ making an angle of 45° with each line.

(3) Resolve along two lines at right angles to each other velocities of 3, 4, 5 and 6 $\frac{\text{ft.}}{\text{sec.}}$, making an angle of 30° with one line and of 60° with the other.

(4) A snail is crawling along a stick with uniform velocity, and the stick is being moved along with uniform velocity in a direction at right angles to its length. Determine the actual motion of the snail.

(5) The wind blows from a point intermediate between south and west. The southerly component of its velocity is 12 $\frac{\text{miles}}{\text{hour}}$, and the westerly 40 $\frac{\text{miles}}{\text{hour}}$. Find the whole velocity.

Key to Exercise 2

(1) 240 $\frac{\text{ft.}}{\text{sec.}}$, 840 $\frac{\text{ft.}}{\text{sec.}}$, 1,200 $\frac{\text{ft.}}{\text{sec.}}$, 2,400 $\frac{\text{ft.}}{\text{sec.}}$, 3,600 $\frac{\text{ft.}}{\text{sec.}}$

(2) $7\frac{1}{3}\ \frac{\text{ft.}}{\text{sec.}^2}$; 975 ft. (3) 20 sec.; 2,000 ft.; 4 sec. the other solution of the quadratic $t = 36$ must be rejected because the body comes to rest in 20 sec. (4) 256 ft.; 128 $\frac{\text{ft.}}{\text{sec.}}$. (5) 90 ft.

M. A. L.

Continued from page 49.

ART AND MUSIC:

Contributors:—THE THEORY OF ART (Hon. John Collier; J. G. B. Lynch). DRAWING AND PAINTING (J. G. B. Lynch). THE THEORY OF MUSIC (R. R. Terry, Mus.Doc., F.R.C.O.; Hubert Grant).

DRAWING.—XVI

THE Greeks drew up an arbitrary code of proportion, which constituted the most perfect human form according to their ideas. In the case of the female figure, the Venus of Milo was looked upon as the standard of true female classical beauty.

In the case of the male figure, the Apollo Belvedere served as the true guide for the perfect male classical figure. These patterns of perfection in the human form were used by the Greek Idealists, but it is impossible for us now to follow any absolutely hard and fast rule.

Do not, however, imagine that the study of the Greek ideal is unnecessary. On the contrary it is extremely useful, for it gives you a solid groundwork upon which to build.

In drawing the modern figure you would, however, be foolish to follow closely the rules of proportion laid down by the Greeks—unless, of course, you wished to produce some classical study.

Take, for example, the faces of our accepted types of English beauty to-day. Few, if any, conform to the Greek table and, in fact, they vary considerably as to details of proportion even amongst themselves.

You will remember that it has already been pointed out in our last lesson that the outline of the face and head is obtained by drawing an egg-shaped or oval figure.

In addition to the examples already given there is another instance in which you may again make use of the oval, and that is in drawing the outline of the head when the axis is horizontal. Professor Camper, who made a special study of the structure of skulls, both of adults and infants, has given in this connection some very interesting hints and directions.

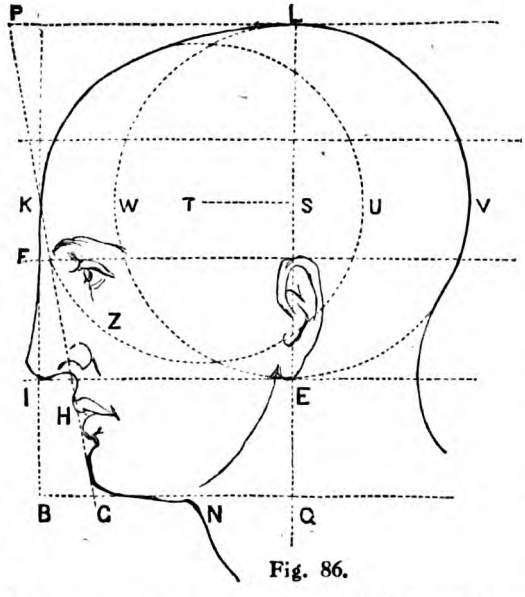


Fig. 86.

He says:—"An idea suggested itself that in drawing the head, the best method would be to imitate the process of nature; first to form the cranium or skull, then mark the facial line in the direction required and afterwards arrange the other parts according to given proportions. The skull is a horizontal oval of which the hindermost parts are the larger, and the forepart like the section of a globe. I first draw this oval by means of two circles; the one is L V E W (see figure 86) which contains about three parts of the head; the other K U Z which is in size eight-ninths of the other circle. Draw the horizontal line S T which extends from the centre of the large circle S to T the centre of the smaller, and is one fourth of the larger circle. From the centre S I let fall the perpendicular line S Q; this marks the seat of the orifice of the ear and its lobe E."

If you look carefully at Figure 86, which Professor Camper gives to illustrate what he says, and measure the diameter of the circles you will find that the smaller is eight-ninths of the diameter of the larger circle. You will also find that the difference between the two centres T and S is one-fourth of the diameter of the larger circle. I draw your attention to these facts as you might imagine that the areas of the circles are referred to. Let us follow the Professor a little further:—

"I draw P G the facial line, in the degree of the inclination required; K marks the place of the forehead; F the line of the eye; I the nose; H and the third I B or I G the mouth; through the centre of L Q I draw the horizontal line F. I also make G N equal to the nose, and from N begin the line of the throat."

Consequently the great advantage of employing

an oval to form the outline of the head lies in the fact that by using this method you will obtain the general formation of the skull, and so get accurately the proportion and the position of the features in relation to each other.

One of the simplest and best ways of studying the various formations of the head and figure is to make frequent visits to a gallery or museum in which there is a sculpture section, and as every large town throughout the country possesses a good collection of casts modelled from the works of the greatest sculptors, it is open to nearly every student to improve his knowledge by such practical observation.

No two heads are alike, and no two figures present precisely the same proportions, as you will readily perceive by noticing the faces and figures of the passers-by as you walk along the street. Bear in mind that once having mastered the rudiments of your art nothing is more calculated to kill originality, which is the essence of true art, than imitating some particular style or the work of some particular master too closely.

If you remain too long under the same tuition, your style is apt to become cramped and your treatment insipid and without character. You must guard against becoming too subservient to the ideas of your master, for if you do you will prevent your own style from asserting itself.

Original Expression

As I write I have in mind an incident that occurred some twenty years ago which illustrates the truth of this. At that time a young student was studying at one of our most famous schools of art, presided over by a very celebrated painter. After he had studied in this school for some time he had assimilated, as far as he felt it was prudent, the method of his master and, let me hasten to add, that these methods were most excellent in every respect. He began therefore to exercise his own judgment in the method and treatment of his work rather freely. This attracted the notice of his master, who expostulated and said that, in future, he must follow the rules laid down for the students of the school. My friend, however, took the bold line and in an amicable interview explained his point of view and left the school.

His future success proved that his conviction was correct. He knew that he had assimilated all that was useful to him in the teaching of that school, so he went abroad and studied fresh methods. To-day he is one of our most eminent and successful painters.

Almost every student, whatever his subject, whether it be painting, poetry, or music, begins by imitating. He has to familiarise himself with the method and the means of expression of his particular art. To learn how to use his materials, to know their precise functions and limitations, will be one of his first tasks.

Concerned at first more with form than with matter, he will make use of some idea or subject already expressed by an artist or writer; gradually his own style will develop, and with it something new to say.

J. G. B. L.

DECORATIVE ART.—III

THE following is the description of what I have called the elaborate dining-room, as opposed to the simple little sitting-room given in the last lesson.

Here we have a large, finely proportioned room, high, but not too high in proportion to the length and breadth. At one end there is a big window with small leaded panes divided by heavy stone mullions.

This is an old room with its original panelling dating from the time of James I. The panels are small and their framework is simple, but the cornice is carved and fluted, pilasters here and there were added about a hundred and fifty years later.

An Elaborate Dining-room

These pilasters with elaborately carved heads appear on either side of the door which opens from a corner and has above it a kind of half-dome or cupola. Here as elsewhere in the room periods and changing tastes are mingled without clashing. The ceiling is richly ornamented with plaster work. The fireplace is open and over it is a beautifully carved mantel with a narrow shelf.

At the end of the room facing the big window is a large buffet with closed cupboards. On the side of the room opposite the fireplace is a side-table and there is another near the window. The dining table itself is a fine specimen of its period with enormous bulbous legs, black with age. There are two arm-chairs of the Charles II. period and other chairs of the same kind but without arms. By the fireplace are two or three more, only of a rather more comfortable sort.

There is a big Turkey carpet in the middle of the room and a heavy Persian rug by the fire. There are very few pictures—portraits for the most part by old masters. But there are some fine pieces of Oriental china on the side-table and the buffet, and a few plaques are hung on the wall.

All the adjuncts to meals, cruet-stands, bottles, and so on, are kept out of sight when not in use. Huge curtains of very dark purple velvet hang gracefully before the windows.

On one of the side-tables there are a flagon or two and some dishes of Queen Anne silver, as well as a carved oak napkin press which dates from the early years of Charles I.

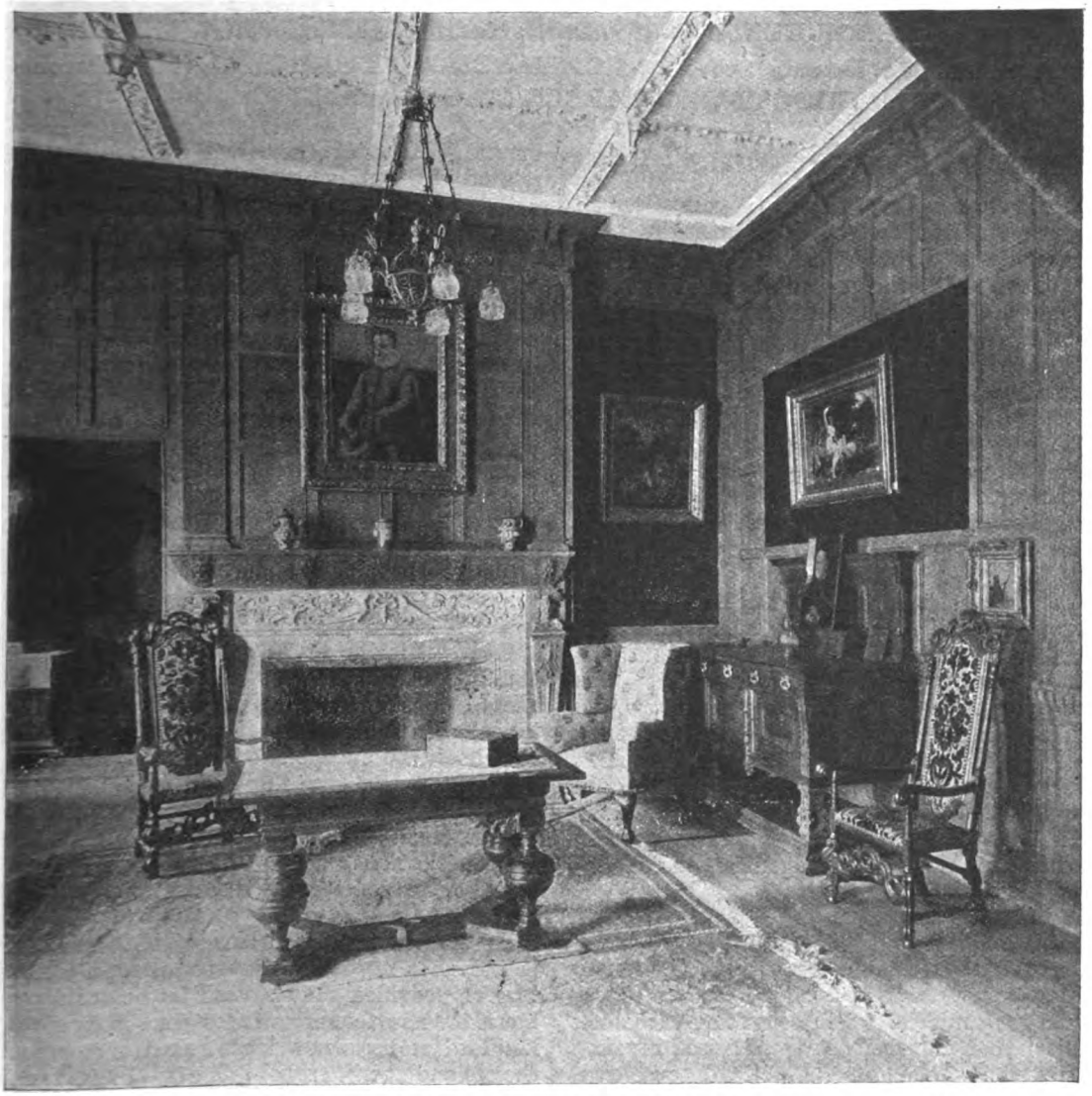
Here again as in the simple room there are no knick-knacks, and again this room with

all its gorgeous furniture, its velvet curtains and upholstery and priceless china would be nothing but for good proportions in the building of it.

Perhaps a manner of furniture which lends itself more readily to elaboration and superficial decoration would be of the later kind—chairs and tables of the time of Queen Anne or perhaps the work of Sheraton or Chippendale.

But it is always interesting to compare these costly possibilities with the equally or even more costly vulgarities which are well beloved by people without taste or artistic perception. Think of curtains of mustard-coloured or orange plush, a multiplicity of ornate looking-glasses, crowded furniture which has not the merit even of being comfortable, and staring wallpaper: then think of plain brown paper, the etching framed in black, the plain Windsor chair and even a kitchen table with a cloth of dark blue and an earthenware pot of hedge flowers. In the latter you can live and work without distraction, in the former every corner would be a weariness to the eye and, however unconsciously, a depression to the spirit.

J. G. B. L.



A SEVENTEENTH-CENTURY DINING-ROOM,

beautifully proportioned, beautifully furnished, and almost severe in its simplicity.

Continued from page 56.

BUSINESS AND COMMERCE

Contributors:—BOOK-KEEPING (Frederick Heelis, F.C.I.S.). SHORTHAND (by arrangement with Pitman's Schools). COMMERCIAL TRAINING (Arthur Brooke) CHOOSING A CAREER (A. C. Marshall).

COMMERCIAL TRAINING.—XXIV

THE following are the chief points to be borne in mind when negotiating for the purchase of a retail business:

1. Why is the present owner selling? Some very good answer must be sought and obtained to this question; unless of course death has been the cause; bankruptcy or some equally apparent reason.

2. What is the history of the business? The answer to this question lies in discovering the original owner of the shop, a statement of the profits over a considerable number of years, and, if the shop has gone down commercially, the precise reason for its decline.

3. What have the profits been for the previous five years? This question should be answered by a qualified accountant employed by the would-be purchaser. This accountant should have full access to the books and stock, and should be able to verify all figures given, to see income tax vouchers and similar documents. No layman should undertake the task of verifying statements of figures; and the fees payable to an accountant should never be grudged in such an important matter.

Stock Taking

4. What is the stock worth? Obviously there must be a full and detailed stock-taking; and the value set upon the stock is *not* that appearing in the original invoices from the wholesalers. Practically speaking, all stock depreciates with time; and a fixed allowance must be made for this depreciation, 5, 10, 20 or even more per cent. As a matter of fact, there are specialist valuers in all trades; and when going into the matter of purchasing a shop it is economical in the end to employ the services of a trade valuer to give his attention to the subject of stock.

5. What about book debts? At any given day there must be on the books of any retail concern a number of accounts that remain unpaid. Most of them will probably be related to purely current accounts that will be settled at the end of the week or month, as the case may be.

At the same time, there are almost certain to be a number of debts of long standing; and these must be viewed by the purchaser with suspicion. As a matter of fact, it is a very good plan for the newcomer *not* to take over the debts of the former retailer. In some instances the new man may act as a collecting agent on the basis of a small commission on all money so collected; but no purchaser should in any circumstances accept book debts at their face value when considering the price of a business that is on offer in the open market.

Security of Tenure

6. What is the rent and cost of upkeep? One of the first points a would-be purchaser should consider is that of rent, rates and taxes, and the security of tenure. A solicitor should be engaged to examine the lease or agreement; and the landlord must be approached to obtain his consent to the transference of the lease or agreement, to its cancellation and the granting of a new term, or to some other arrangement being made.

In the case of trade leases, the landlord usually has no option but to accept a new tenant, provided he is proved to be suitable; but if the new tenant can rent direct from the landlord under a new lease, and can cancel the old one, it will probably be to his eventual advantage.

And, in going into the question of tenure, some provision must be made for the tenant to have the option of renewal upon agreed and fixed terms; and, in some circumstances, the option of purchase.

7. What is the old tenant going to do? This point is more vital than it may appear. It frequently happens that a retailer, feeling tired of business and possessed of a shop that will yield a good round sum for good-

will, decides to retire. He sells his business; but before very long finds that he will be happier if he returns to the old calling.

In such an eventuality, it is only natural that the retailer should seek to return to the scene of his former business so that he may to some extent profit by his old connection. So that when purchasing a business, this contingency should be foreseen; and a clause should be inserted in the deed of purchase, prohibiting the seller from setting up in business within a given radius of the old shop.

Having obtained suitable answers to all these questions, and being thoroughly satisfied that the business is at all events capable of being worked up, the purchase may be proceeded with; and it is highly advisable that the actual documents shall be of a legal nature, prepared by a solicitor, the charges being often shared equally between buyer and seller. The actual date of transference must be decided upon; and questions as to the retention of the old assistants or the engaging of new ones discussed.

Old-established Names

As for the actual payment of the goodwill of the business, this is occasionally arranged on a mutual understanding that the money is paid over a term of years. In this event a deed of mortgage would be executed in favour of the seller; and, though a part of the purchase price would be paid outright, the remainder might stand for an agreed number of years under the mortgage at a fixed rate of interest, or upon definite terms of repayment by annual or other instalments.

Other matters that would have to be considered would be the name and style of the business. With old-established concerns it is sometimes inadvisable to make an alteration; and the substitution of a new name frequently exercises a prejudicial effect upon a business.

What often happens is that the buyer takes over a business and runs it for a year or so under the old style; then, very guardedly and gradually, he begins to substitute his own name, first on the billheads, then on the advertisements, and finally on the fascia itself.

We may now therefore make some comparison between founding a completely new business, and purchasing an established one. In the first place, it will be seen that the retailer starts, as it were, from zero and works up his own connection. He receives no specific recompense for all this trouble; but just so long as his business grows, so does the value of the goodwill.

And students of business training should review this point closely, remembering that whereas a paid assistant works by the week, is paid by the week, and can be dispensed with at the end of a week with nothing to back him beyond his experience, the master man, even if he be in quite a small way of business, is building and constructing all the time; so that by the end of his working days he possesses some real, tangible, marketable thing—the goodwill of a business to which he has devoted so many years of his life.

Value of Goodwill

On the other hand, the man who buys an existing business is actually creating nothing, but is working upon the basis of a ready-made connection. He must remember that in some circumstances it might prove more profitable to sink his capital into a new business rather than to buy an established one; and also that when once he has paid a goodwill he will have to work and strive not only to maintain the value of that goodwill, but actually to improve upon it.

As to the value of the goodwill of a business, it is not at all a difficult matter to form an accurate estimate. Let us take £500 as a basis, and assume that it has to yield 6, 7, or 8 per cent. net, which is a very fair return from commerce.

We have therefore to show at the end of the year that the profits of the business, after writing off a liberal amount for depreciation of stock and appliances, paying all expenses, and making a definite allowance for the time and energies of the owner himself in his capacity as manager of the business, equal 6, 7, or 8 per cent. per annum of the capital invested.

But the business student must note particularly that the owner of the concern is adequately paid for his own time and labours. Without making this provision the calculation becomes valueless.

Many retailers find that it is highly profitable to run two businesses in different parts of the town; and this applies more particularly to outfitters, hosiers and haberdashers.

In such circumstances, a large stock can be purchased on favourable terms, and the goods that do not sell readily in one shop may often be disposed of in the other; for naturally the two shops will appeal to different types of patrons.

A. B.

CHOOSING A CAREER.—XXVI

Journalism (*continued*).—As staff appointments, positions as fiction and article writers are becoming fewer and fewer, and editors are relying more and more upon the work of the *Freelance Journalist.*

The freelance is an unattached writer of proved worth who has built for himself a strong connection among the editors of periodicals. In the majority of cases freelances have enjoyed at all events a brief office experience and editorial training, but there are innumerable instances where workers have graduated from other professions or actually commenced their careers by writing.

The only qualification necessary is the ability to write either fiction, articles, or poetry of such merit as to meet an editor's approval and acceptance. Would-be freelances should carefully study the papers to which they would wish to contribute, noting the actual requirements, and only submitting matter that falls into the category of the contributions regularly used. And this advice applies equally to fiction as to articles, for one editor will use tales of adventure, another domestic stories, and a third mystery and romantic narratives.

Even the length of the contributions submitted should be taken into consideration, and a paper that uses many column articles would probably only desire to entertain contributions of that length. Again, it would be useless to submit a 10,000-word story to a journal that only utilises short tales of 2,000 words.

A preliminary letter is in most cases inadvisable, and with most of the popular papers MSS. may be submitted direct to the editor. When offering a serial story, the best plan is first to ascertain by counting in a copy of the actual paper the length of instalment generally used. A first instalment of the story should then be written exactly to length, and be submitted to the editor with a brief synopsis of the succeeding instalments.

Serials are almost invariably written in separate instalments, and vary between 50,000 and 150,000 words in length. The *Authors' and Artists' Year Book* is a useful annual containing the names of the various British and American journals to which the freelance may submit work, together with brief hints as to the type of contribution desired by the respective editors.

There is sometimes a little delay in the reading of submitted MSS., and a further delay between acceptance and publication. Payment is generally made on publication or early in the month following issue. Very successful freelances are often bound by contract to contribute only to one firm, or to one group of papers.

And here may be uttered a word of warning to the beginner. On the fringe of the profession there are many so-called literary agents who profit by the efforts of the amateur, demanding large preliminary fees for the reading of MSS., and commission on a high basis should they be successful in placing a contribution. Some of these men act unfairly towards the person starting out in journalism, and are to be approached with caution, more particularly those who demand extortionate fees.

At the same time it is only just to say that there are many most honourable and trustworthy literary agents, who will dispose of the work of freelance writers *not* charging a preliminary fee at all, but merely a reasonable commission upon all work actually disposed of and paid for.

Authorship, that is, the publication of one's work in book form, is usually the outcome of experience in journalism. Of course, there are many authors who have never written anything but books, though newspapers and periodicals may be said to pave the way to books.

One of the points about journalism is that it may become a profitable spare-time calling, and there are many successful freelances who follow other callings, devoting only their leisure to writing. Many freelances start in this way only to find after a time that their writing is becoming more profitable than their original calling, and it is a feature of journalism that both men and women enter its ranks at all sorts of ages, and, so long as they can perform the work expected of them, they are quite as welcome as the junior who started at the very bottom.

At the same time it should be explained that we do not hold out journalism as an ideal, feather-bed profession in which there is very little to be done to attain to high rates of pay. Journalism is as exacting as it is precarious, and old age is a period not to be faced light-heartedly by a man who is "written out," and whose style has lost its virility and freshness.

So far as the earnings of freelances are concerned, there are many writers of popular fiction enjoying a four-figure income, and a good, steady writer of articles with a certain market might well count upon earning from £6 to £10 a week, or even more in exceptional circumstances. A. C. M.

BOOK-KEEPING.—XX

It is not unusual nowadays to see announcements made by prosperous Trading Companies to the effect that they have "Branches everywhere." Especially so is this the case in grocery and provision, boot and shoe trades, etc., and in banking.

Branch Accounts

The keeping of Branch Accounts, whilst not complicated, requires care.

As our first example let us take the method by which the book-keeping is done at the Head Office from information which the Branch Office supplies. In this case, the Accounts are similar to the Departmental Accounts already explained in Lesson No. 8.

From the following particulars we will prepare the Accounts of Branches A and B in the Head Office books. All the Sales of the Branches are for ready money and all the goods sent to the Branches are invoiced at cost price.

	Branch A.			Branch B.		
	£	s.	d.	£	s.	d.
Stock 1st Jan., 19..	700	–	–	600	–	–
Goods sent from Head Office ..	5,000	–	–	4,500	–	–
Goods returned to Head Office ..	90	–	–	50	–	–
Wages Paid ..	400	–	–	380	–	–
Rent of Branches	110	–	–	100	–	–
General Expenses	75	–	–	63	–	–
Proceeds of sales remitted to Head Office	7,300	–	–	6,900	–	–
Stock 31st Dec., 19..	900	–	–	850	–	–
	£14,575	–	–	£13,443	–	–

The above Accounts are the Trading Accounts of the two Branches.

Instead of invoicing goods to Branches at the cost price as in the case just shown, it is sometimes deemed desirable to invoice them at a fixed percentage above the cost price or even at the actual selling price. Where goods are invoiced at a fixed percentage above the cost price, it is advisable to use two columns in the Branch Account, and great care must be exercised to ensure that the calculation of selling price is correct.

Suppose for example, that you invoice goods to your Branches at 20 per cent. above cost price. The Branch Account will show two columns, one with the invoice value of the goods, and the other with amounts 20 per cent. less. If the cost price is given, then it is an easy matter to reckon the invoice price by adding 20 per cent., but where the invoice price is given, the calculation of the cost price is not so obvious.

For example, if the cost price is £100, and the goods are invoiced at 20 per cent. above cost price, the invoice price will be £120. The deduction on £120 is thus £20, which represents one-sixth. If, therefore, the invoice price is given in such a case, it will be necessary to deduct one-sixth of the amount in order to arrive at the cost price.

It is only the difference between the cost price columns which must be taken into account in the above example, as the difference between the invoice prices represents merely an estimated profit.

The third method of invoicing goods to a Branch is at selling price, so that by giving the Branch the price at which it must sell, the Head Office keeps a check on its working.

BRANCH A ACCOUNT.

	£	s.	d.		£	s.	d.
To Stock	700	–	–	By Goods to Head Office	90	–	–
„ Goods from Head Office	5,000	–	–	„ Proceeds of Sales (sent to Head Office)	7,300	–	–
„ Wages	400	–	–	„ Stock	900	–	–
„ Rent	110	–	–				
„ General Expenses	75	–	–				
„ Profit and Loss Account (Profit)	2,005	–	–				
	£8,290	–	–		£8,290	–	–

BRANCH B ACCOUNT.

	£	s.	d.		£	s.	d.
To Stock	600	–	–	By Goods returned to Head Office	50	–	–
„ Goods from Head Office	4,500	–	–	„ Proceeds of Sales (sent to Head Office)	6,900	–	–
„ Wages	380	–	–	„ Stock	850	–	–
„ Rent	100	–	–				
„ General Expenses	63	–	–				
„ Profit and Loss Account (Profit)	2,157	–	–				
	£7,800	–	–		£7,800	–	–

The following rulings are used in books for recording the supplies of goods to Branches.

Purchases Book and a Sales Book for each Branch, and separate Branch Stock Books, and in some cases separate Branch Ledgers.

Date.	Particulars.	Total.	Branch A.	Branch B.

Date.	Particulars.	Total.		Branch A.		Branch B.	
		Invoice Price.	Cost Price.	Invoice Price.	Cost Price.	Invoice Price.	Cost Price.

In the examples shown thus far, all the sales have been for cash, but it frequently happens that a Branch sells both for cash and on credit. When this is the case, the treatment may depend upon whether or not the transactions are large and numerous, or small and infrequent. If the latter is the case, the Branch Account may be kept in a similar manner to the one previously shown, except that the debtors are treated in the same way as stock.

Where, however, the credit transactions are large or numerous, it is preferable to have separate Branch Accounts, such as Branch Goods Account, Branch Expenses Account, Branch Debtors Account, and Branch Profit and Loss Account.

The following will illustrate this, so far as the form of accounts is concerned. The figures can be filled in as desired.

In some businesses, it is found expedient for the Branch to keep its own books in a complete form, submitting to the Head Office its Trial Balance for incorporation into the Head Office Books. In the Head Office Books the entries would usually be made in Journal form in a similar way to Closing Entries, such as those which were shown in our last lesson. There will always be a state of indebtedness between the Branch and the Head Office, and in the Books of the latter the Branch Account will be debited with goods supplied, whilst cash received from the Branch will be credited. The reverse process will be followed in the Books of the Branch.

BRANCH ACCOUNT.

19..			19..		
Jan. 1	To Stock		Jan. 1	By Cash	
,, ,,	,, Debtors		,, ,,	,, Ledger a/cs	
,, ,,	,, Goods from H. O.		,, ,,	,, R. M. Sales	
,, ,,	,, Rent, Rates, etc.		,, ,,	,, Returns to H. O. ..	
,, ,,	,, Wages and Salaries ..		,, ,,	,, Stock	
,, ,,	,, P. & L. a/c (Net Profit)		,, ,,	,, Debtors	

In the case of Wholesale businesses which have many Branches and which carry on their operations on a large scale, the books of the Head Office may be kept on the Departmental System, that is to say, there is practically a complete set of books for each Branch. For example, there will be a

Definition of Terms

Letter of Credit (L/C).—The letter addressed by a banker or merchant to a correspondent or representative either at home or abroad, requesting him to advance to the bearer a fixed or unlimited sum, debiting the amount thus paid to the writer's account.

Bills of Sale.—A document assigning property. Usually given as security for loans of not less than £30.

F. H.

SOME INSECTIVOROUS PLANTS.

1. Pitcher Plant (*Nepenthes*); **2. Side-Saddle Plant** (*Sarracenia*); **3. Sundew** (*Drosera*); **4. Venus' Fly Trap** (*Dionaea*); **5. Bladderwort** (*Utricularia*); **6. Darlingtonia.** (*See pp.* 140, 141, 142.)

Continued from page 63.

ENGLISH LANGUAGE AND LITERATURE:

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THE NOVEL.—II

THE women novelists who, in outline, filled in nearly fifty years of fiction between Sterne and Scott were Fanny Burney, Clara Reeve, Ann Radcliffe, Maria Edgeworth, Jane Porter, and Jane Austen.

Fanny Burney was born at King's Lynn in 1752, the daughter of Charles Burney, a popular doctor of music. While she was a child the family moved to London, and their house became a cheerful social centre frequented by well-known people. From an early age, through many years, Fanny kept a sprightly diary which is one of the best books of its kind in the language. Its publication did not begin till 1842.

Fanny Burney, or—

In 1778 appeared a novel in three volumes entitled *Evelina, or a Young Lady's Entrance into the World*, which took the town by storm, the more so perhaps because the authorship was a pleasant mystery. By and by it became known that Dr. Burney's shy and pretty little second daughter had written secretly the book which Dr. Johnson was estimating as worthy of his old friend Richardson. Fanny soon became an admired member of the most select literary circles, and a pet of the surly but susceptible Johnson.

In 1782 she confirmed her swiftly won reputation by publishing, in five volumes, *Cecilia, or Memoirs of an Heiress*. In 1786 this cleverest and most sensitive woman of her day was appointed to the absurd position of second keeper of the Queen's Robes, the First Keeper being a gross and vulgar German woman named Schwellenberg. The only redeeming feature of this outrageous appointment was that Miss Burney continued to write up her *Diary*, and in it the world can now find pictures of life at court more vivid than any ever penned.

When the little lady had nearly killed herself by a faithful performance of menial duties in the Queen's apartments she was retired, in 1791, on a pension of £100 a year.

Two years later she married General D'Arblay, a poor French refugee. Her third novel, *Camilla, or a Picture of Youth*, followed, in 1796, in five volumes, and enriched her by £3,000. After living for ten years in France, where her husband had an appointment under the Empire, Madame D'Arblay returned and, in 1814, published, in five volumes, *The Wanderer, or Female Difficulties*, which brought her another £3,000, but was otherwise a failure. A life of her father, issued in 1832, showed a sad decline from the ease and brightness of her early style.

Two years after her death, in 1842, at the age of eighty-seven, the commencement of the publication of the familiar *Diary* fully renewed the reputation which had been brilliantly won as Fanny Burney, and rather drearily lost as Madame D'Arblay.

—Madame D'Arblay

After the manner of Richardson, or more nearly of Smollett in *Humphry Clinker*, the story of *Evelina* is told in letters from the various characters in the novel. This involves what to us to-day would be the unnaturalness of minute reports of long conversations; but in the days of unrestrained letter-writing the outpourings of a seventeen-year-old heroine's correspondence could not, perhaps, appear too copious.

In her *Diary* Miss Burney had practised the art of etching a character firmly and deeply in a few words, and in *Evelina* the character-drawing is swift and clear. The first outlining strokes make her people

live. The humours of sharply contrasted social grades—polite society on the one hand and the pretentious vulgarity of its distant imitators on the other hand—are used with an infectious enjoyment. The heroine is in an awkward fix between her own innate refinement and good breeding and the gaucheries of vulgar relations on her mother's side who find her out. A coarse sea captain, borrowed from Smollett, gives some of the scenes a boisterousness verging on horse-play.

It was this rougher side of the book that was most pleasing to its literary readers in the Johnsonian circle ; but apart from Miss Burney's biting scorn for social pretence there was character-sketching delicate and true, foreshadowing the later art of Jane Austen, and a vivacity and movement unsurpassed before or since. *Evelina*, in short, remains a very notable work in the evolution of British fiction.

Unfortunately Fanny Burney, who had in her a clear strain of genius, was not sufficiently strong and confident to resist outside influences, and she succumbed to the pervasive mastery and paternal airs of Johnson. Each of her succeeding works became more formal and stiff. The brightness, ease, and darting life that had been her charm were toned down in *Cecilia*, lost in verbiage in *Camilla*, and disappeared entirely in *The Wanderer*. As, a century later, George Eliot obscured her genius under a cumbrous philosophy, so Fanny Burney buried hers beneath a stilted pomposity.

Clara Reeve

Besides *Evelina*, the seventh decade of the eighteenth century produced one novel that was often reprinted. This was *The Old English Baron*, by Miss Clara Reeve, daughter of a Suffolk clergyman. It acted as a connecting link between Walpole's *Castle of Otranto* and the widely popular romantic tales of Mrs. Radcliffe, which appeared in the 'nineties. Miss Reeve went to the distant past for her scenes, and so, though she mixed her dates absurdly, kept in the public mind the idea of the historical novel, which had been introduced, somewhat obliquely, by Walpole. From him she also borrowed a tinge of the supernatural, though in the mild form of ghosts.

Mrs. Ann Radcliffe captivated the novel-reading public by three stories which have such a distinctive character that no collection of British fiction which does not include examples from them can be said to be complete. They were *The Romance of the Forest* (1791), *The Mysteries of Udolpho* (1794), and *The Italian* (1797).

Mrs. Radcliffe was a retiring lady, wife of a newspaper editor. Far removed from the ordinary life of the day, her stories were romances brooded over by mystery, and saturated—as Sir Walter Scott pointed out—with suspense. The style was high-flown and poetical. Descriptions of natural scenery abounded, especially of the awe-inspiring, with its suggestion of tragedy.

The aim was to create feelings similar to those springing from a fear of the supernatural, though at last a simpler explanation was always found. The handsome hero or villain was endowed with a strain of romantic wickedness, and became the literary progenitor of the Byronic hero of the next generation. Mrs. Radcliffe introduced, too, a greater ingenuity and intricacy in plot. In her work ornateness reached its limit. Though her over-elaboration repels the modern reader, the general effect is not without power, and as a specimen of a style once admired her writing has a lasting interest.

Maria Edgeworth

The appearance, in 1800, of a novel of Irish life, *Castle Rackrent*, by Miss Maria Edgeworth, marks the beginning of a new departure in fiction—the localised tale. Miss Edgeworth was born in 1767, the eldest daughter of a clever and inventive, didactic and obstinate Irishman, Richard Lovell Edgeworth, of Edgeworthstown, the second of his nineteen children, her mother being the first of four wives.

Richard Edgeworth had ideas on education, partly derived from Rousseau, and he endeavoured to put them into practice with his own family, helped by his daughter Maria. He it was who induced Thomas Day to write the once popular, too-moral book for the young, *Sandford and Merton*.

He also wrote on education himself, and so did his daughter, her works, without the obtrusion of morals, including some of the most delightful tales ever penned for children.

Three of the stories of this sensible and charming lady sketch specially life in Ireland—*Castle Rackrent* (1800), *The Absentee* (1812), and *Ormond* (1817)—and it was the earlier issues which suggested to Sir Walter Scott his attempt similarly to picture Scottish life and character. Miss Edgeworth continued writing till 1834, and after a life of usefulness and honour died in 1849. Her novel best known outside her Irish series, and her inimitable children's tales, is *Belinda* (1801).

During the best part of her writing life Miss Edgeworth was hampered by criticism, alterations, and additions from the heavier pen of her adored father. She lacked constructive power, but in sketching a scene, outlining character, and reproducing conversation was natural and faithful, and she was rich in the humour of her race.

Mention may be made here of another writer of Irish parentage but Scottish upbringing and residence, Miss Jane Porter (1776-1850), who wrote an exceedingly popular story, *The Scottish Chiefs*, published in 1810, which was loosely regarded as historical, but really is a permanent warning against bogus pictures of the past. Its eager acceptance by the undiscriminating public served, however, to call attention afresh to the wide field of history as affording backgrounds for fiction, and possibly prompted some of the later writings of the master-novelist, Scott.

From a Drawing by E. Burney.

FANNY BURNEY (MADAME D'ARBLAY).

one of the six women who supported the burden of the English novel during the period which elapsed between Sterne and Scott.

Jane Austen, the most consummate artist in delineating the domestic life of gentlefolk in rural England, was born on December 16th, 1775, at Steventon, in Hampshire, where her father was rector. With the exception of five years lived at Bath, her home was always in her native county. She died at Winchester, July 18th, 1817, and is buried in its ancient cathedral. Her life was as uneventful as the lives of the ladies whose characters unfold themselves as we read the six stories which, with continually growing certainty, have established her fame.

The dates of the publication of those stories were *Sense and Sensibility*, 1811; *Pride and Prejudice*, 1813; *Mansfield Park*, 1814; *Emma*, 1816; and *Northanger Abbey* and *Persuasion* in 1818, after the writer's death. The writing of the stories divides them into two groups, for *Northanger Abbey*, *Pride and Prejudice*, and *Sense and Sensibility* were written between 1796 and 1798, but failed to find a publisher for more than twelve years. Then, after *Sense and Sensibility* had secured publicity and success, the other three stories were written between 1812 and 1816.

Jane Austen's later novels were issued contemporaneously with Scott's first tales; but in reality her true period was almost twenty years earlier. Her impulse to write came when Mrs. Radcliffe was in the heyday of her popularity, and *Northanger Abbey*, the youngest of the tales in spirit, and one of the first to be written, though the last to be published, was a gentle satire on the gush and inflation of the romantic school; and all the novels are a reversion to everyday life and reality from the fanciful exaggerations and vamped up sentiment of the fiction of mystery, wonder, and nervous tension.

Jane Austen makes the lives of people, lived in an average way, full of varied interest, without the use of an intricate plot, or exciting incidents, or strong passions, or dramatic alternations of joys and sorrows.

It is enough for us to watch the unfolding of character through self-revelation, and the play of individuality on individuality, in people who became as real to us as those whom we know in our daily round. Her pictures of the social circles she knew best are

faithful to the last detail, and are brightened by a humour that is at once keen and delicate.

Beyond that circle she would not venture, for she knew to a nicety the range of her powers. Within the limits she had marked out for herself her literary art was sure and exquisitely balanced. While *Pride and Prejudice* is the most perfect illustration of her early work, and *Emma* of her later work, no book that she wrote can be neglected without loss, for there is no English writer reaching the classical standard who so uniformly sustained a high level of achievement.

With the entry into the nineteenth century the novel covered almost as wide a field as it does to-day, except for the much later excursion into psychological analysis, and the imminent development of historical fiction under the epoch-making genius of Scott, to which our attention must next turn. J. D.

PHILOSOPHY.—IV

In contrast with thoroughgoing materialism and spiritualism which proclaim the monism of matter or mind to the total exclusion of the opposed reality, there are various attempts to be discussed which recognise the claims of both and seek to find a *via media* between them.

Descartes

Descartes, in setting out on an intellectual and moral voyage to discover truth, determined to refuse his adherence to any proposition except such which was so clear and distinct that it could not possibly be doubted. The most obviously clear and distinct proposition to him was the fact of his own existence—his self-consciousness.

He could bring himself to doubt the existence of matter, he knew that appearances were often deceptive, that reasoning was often fallacious, that memory might be as unreliable as expectation, but he could not possibly doubt that he himself existed, for the very doubt would imply the existence of his thinking self. *Cogito ergo sum*—I think, therefore I am. With this principle of certitude as a lode-star to guide him, together with certain other propositions which he held to be irrefutable, he claimed to be able to deduce and to demonstrate a number of other truths. He looked within himself and found only imperfections and limitations; but he had a clear and distinct idea of something which was not himself, which was perfect, without limitations, eternal and unchangeable: therefore this something existed, and he called it God. From the idea of God, which he regarded as "innate," i.e. not derived from experience, he deduced the doctrine of the two substances, spirit and matter.

In the highest sense of the word there is only one *substance* (Latin, *substans*, not to be confused with the substance or matter of which objects are said to be composed) and that is God. He is infinite and self-existent, being neither caused nor conditioned by anything else. The two substances, spirit and matter, are derived from this One, are conditioned by it alone. The essence of matter is extension, for if we try to conceive of matter which does not occupy space, we lose the idea of matter completely.

Seat of the Soul

Similarly, the essence of spirit is thought, anything else that exists in the mind is but a modification of thought. Extension and thought are not identical; not only can mind be conceived independently of extension but is in itself the very negation of extension. Hence they are totally different: and what is true of thought and extension in the abstract is equally true of their concrete forms, mind and body. The connection between these is a purely mechanical one, God being the go-between. The body is an automaton made by God in which the soul takes up its abode, and it differs from a machine inasmuch as it is the temporary seat of the soul. The exact location of the soul in the human body was for long a debatable point between philosophers. Descartes located it in the pineal gland, because that is the only part of the brain which has no duplicate; if it resided in any other region of the central organ, we should perceive objects double.

The Cartesian ontology was thus a dualism of two opposed realities, matter and spirit, and the only connection between them was that brought about by the direct intervention of the deity. This *Deus ex machinâ* becomes a *Deus in machinâ* whenever mind and matter interact — it is the only bond of union between them.

Spinoza followed the same method as Descartes, pushed it to its logical extremity and so arrived at a seemingly more satisfactory reconciliation of the claims of mind and matter. He framed a set of eight definitions and seven axioms, and from these he deduced his propositions in the approved

JANE AUSTEN (1775–1817).

A charming study by the sister of the author of *Pride and Prejudice* and many other faithful and delicate studies of the social circles which she knew.

Euclidean manner. He also took consciousness as the basis of all certitude, and what was capable of being clearly conceived, and involved no logical contradiction, he took to be objectively true. Consequently, metaphysical problems could be treated like mathematical: and this manner of treatment he regarded as ideal, not only on account of its certainty, but because it was based upon pure reason, leaving no loop-hole for the ingress of passion or sentiment, "which more than anything else obscures men's minds from the vision of truth."

Spinoza and Leibnitz

Spinoza gave his adhesion to the Cartesian idea of *substance* as the alpha and omega of existence, but he declined to recognise spirit and matter as substances, even of a derivative order. The one and only *substance* he also called God or Reality, but it was not a personal God. He affirmed nothing about it except that it had existence, for by ascribing to it such attributes as will, intelligence and extension, he would be setting limits to it. God might have an infinite number of attributes but none which would imply delimitation (*omnis determinatio est negatio*). Spirit and matter are not substances, and they are not attributes in the sense used by Descartes. They are the forms under which God or Reality is perceived by, or manifested to, the human mind —they belong rather to the sentient subject, not to the infinite, absolute and eternal Substance.

In agreement with Descartes, Spinoza held that matter and mind were essentially different in nature, each is independent of the other, but whereas Descartes admitted interaction by the interposition of the deity, for Spinoza there was no kind of reciprocity between them. A physical event could not be the cause or the effect of a psychical event, for was it not laid down in his Third Proposition that "Of things which have nothing in common, one cannot be the cause of the other"? Therefore mind cannot act on matter, nor matter on mind. If, however, the possibility of interaction is precluded, there is yet a complete correspondence or parallelism between the two. To every physical event there is a corresponding mental event and vice versa: physical and psychical phenomena follow one another in independent parallel series, each series "going by itself." This is the position of the modern theory of psycho-physical parallelism which thus owes its "Grundgedanke"—its underlying and essential principle — to Spinoza.

In direct opposition to Spinoza, Leibnitz conceived of substance as a *plurality*, as an assemblage of units which he called *monads*. The essential characteristic of these units, and therefore also of substances, was the possession of *vis viva*, of living force, or as we should say, of energy.

This force is manifested to us either as attraction or repulsion. As an illustration he takes the case of a stretched bow which, as soon as it is released, moves itself and expands by its own innate energy. Everything that is, spirit and matter, is composed of monads, which are infinite in number, self-existing, and eternal. Unlike the hypothetical atoms of Democritus and of modern science, they are not extended, for space exists only in the mind of the subject, and therefore they are not divisible, not even in thought. They are living conscious units, entirely unlike and independent of one another, and each one is a microcosm in which the macrocosm, the whole of the world external to it, is reflected.

This view of reality as a multiplicity of monads, together with his doctrine of Pre-established Harmony, enabled Leibnitz to submit a solution of the conflicting claims of materialism and spiritualism. According to this doctrine, material and psychical (mental) phenomena each follow their own laws, the former mechanical laws, the latter aims or purposes; but in the beginning God had arranged such a perfect harmony between them, that the two worked as one and a complete unity resulted. Leibnitz admitted the possibility of three ontological points of view: (*a*) interaction, (*b*) interaction brought about by the direct and continuous intervention of God, and (*c*) Pre-established Harmony.

A Well-known Analogy

To illustrate these conflicting views, he put forward his well-known analogy of the two clocks which always kept exactly the same time. Their synchronism could be explained on the assumption (*a*) that the hands of each were directly connected, or (*b*) that the clock-maker constantly intervened and put one clock like the other, or (*c*) that in the beginning both clocks were made with such exquisite and perfect skill that once started they kept together ever after.

It will be noted that, although travelling by a somewhat different route, Leibnitz solved the ontological problem in much the same way as Spinoza, i.e. mind and matter run parallel to one another, but whereas

Spinoza favoured neither of the two modes under which Substance is manifested to us, Leibnitz showed a distinct bias towards spiritualism, for his monads, the infinitesimal, immaterial bricks out of which the whole universe was built up, were essentially spiritual in character.

This brief account of the views of Descartes, Spinoza and Leibnitz, three of the finest intellects that the world has ever seen, will give the student an insight into the method which was so dear to the thinkers of the past. This *a priori* method of deduction from fixed principles and axioms, which are taken for granted *ab initio*, is open to the criticisms, that the axioms may be open to doubt, and that what is *logically* certain or possible, is by no means always certain or even probable from the standpoint of experience. It does not require much philosophical insight to understand that thought and existence are not necessarily the same ; as Kant said, there is a great difference between *thinking* we possess a hundred dollars and *actually* possessing them.

Induction and Deduction

Early in the 16th century there arose in rebellion against the tyranny of scholastic philosophy, a famous figure in the person of the English statesman, man of letters and philosopher, Francis Bacon ; he ascribed the sterility of thought then, and for a long time previously, existing to the exclusive cult of the deductive method, and enjoined investigators to use the inductive method of appeal to experience and experiment which alone could lead to discovery and progress. According to Aristoteles, there are two kinds of induction, perfect and imperfect. The former is given by the formula : Because all things are so, therefore this particular thing of a similar nature is so ; the latter says : Because many things are so, therefore this particular like thing is probably so. Perfect induction is an infertile method because the conclusion is already included in the premiss, and it is defective because experience can never legitimately affirm that *all* things are so ; the extent to which all things are so can only be arrived at by scientific induction.

The latter consists in framing a general rule or law from a number of single, similar facts of experience, and because the rule is based upon experience it has no absolute validity : hence the conclusion drawn from it (Aristoteles' imperfect induction and scientific deduction) has no absolute validity but only probability. But this very circumstance necessitates the door being left open to observation and experiment.

The method of the scientific investigator thus consists in summarising the facts in a general principle or law (induction), and applying the law to individual, new cases (deduction). To take an illustration. A very large number of observations had shown that the chemical elements could not be " transmuted," i.e. changed into one another.

Lead was lead, gold was gold, and no man had been able to turn the one into the other. The general truth that elements were not transmutable was arrived at by induction. When a new element was discovered, the chemist applied the scientific deductive method and affirmed that since all the elements known to him could not be transmuted, therefore in all probability, neither could this new element be transmuted or obtained by transmutation. Not many years ago a new substance, radium, was discovered which was apparently an element, but which in some respects showed abnormal behaviour ; it not only gave out light but also emitted heat and various other kinds of rays. This continuous emission of heat and rays (other than light) had never been observed in the case of other elements : hence the necessity of further research. Investigation disclosed that from a chemical point of view radium was an element, but that it continuously evolved a gas which the spectroscope identified as helium—a known element.

Accordingly, the law of non-transmutation of elements had to be modified.

Summary

Descartes regarded self-consciousness as the basis of certitude. He inferred the existence of God from his clear and distinct idea of something not-himself which was perfect. From his idea of God he deduced the derivative substances, spirit, the essence of which is thought, and matter, the essence of which is extension.

Spinoza predicated the existence of substance, as the eternal, infinite, and absolute essence of all things. Matter and mind are the forms under which Substance is perceived by us ; they are opposed in nature, there is no interaction but only a complete correspondence between them.

Leibnitz regarded reality as composed of spiritual units endowed with " living force."

The *a priori* or deductive method consists in drawing conclusions from preconceived axioms and truths which are believed to be independent of experience and therefore certain.

Scientific induction is the intellectual passage from the particular to the general.

Scientific deduction consists in applying such a general truth to a particular case. E. H. T.

Continued from page 70.

HISTORY:

Contributors:—**J. A. Brendon, B.A.(Oxon.), F.R.Hist.S.; F. Collinson, F.R.Hist.S.; T. P. Evans, B.A.(Oxon.); James A. Manson; L. Stampa, M.A.(Oxon.); and J. B. Sterndale-Bennett.**

BRITAIN'S STORY.—XI

[*The introductory chapter to* LORD MACAULAY'S "*History of England*" *has been adopted in this work to explain the development of the British race prior to* 1660. *But as Lord Macaulay's work was intended merely as a sketch, explanatory passages* (*printed in closer type*) *have been interpolated in order to meet the requirements of the student.*]

THE founders of the Anglican Church had retained episcopacy as an ancient, a decent, and a convenient ecclesiastical polity, but had not declared that form of church government to be of divine institution. In the reign of Elizabeth, Jewel, Cooper, Whitgift, and other eminent doctors defended prelacy as innocent, as useful, as what the state might lawfully establish, as what, when established by the state, was entitled to the respect of every citizen. But they never denied that a Christian community without a Bishop might be a pure Church. On the contrary, they regarded the Protestants of the Continent as of the same household of faith with themselves. Abroad the ambassadors of Elizabeth and James went in state to the very worship which Elizabeth and James persecuted at home.

Celibacy and the Church

But a new race of divines was already rising in the Church of England. In their view the episcopal office was essential to the welfare of a Christian society and to the efficacy of the most solemn ordinances of religion.

In the days of Edward VI. and of Elizabeth, the defenders of the Anglican ritual had generally contented themselves with saying that it might be used without sin, and that, therefore, none but a perverse and undutiful subject would refuse to use it when enjoined to do so by the magistrate. Now, however, that rising party which claimed for the polity of the Church a celestial origin began to ascribe to her services a new dignity and importance. It was hinted that, if the established worship had any fault, that fault was extreme simplicity, and that the Reformers had, in the heat of their quarrel with Rome, abolished many ancient ceremonies which might with advantage have been retained.

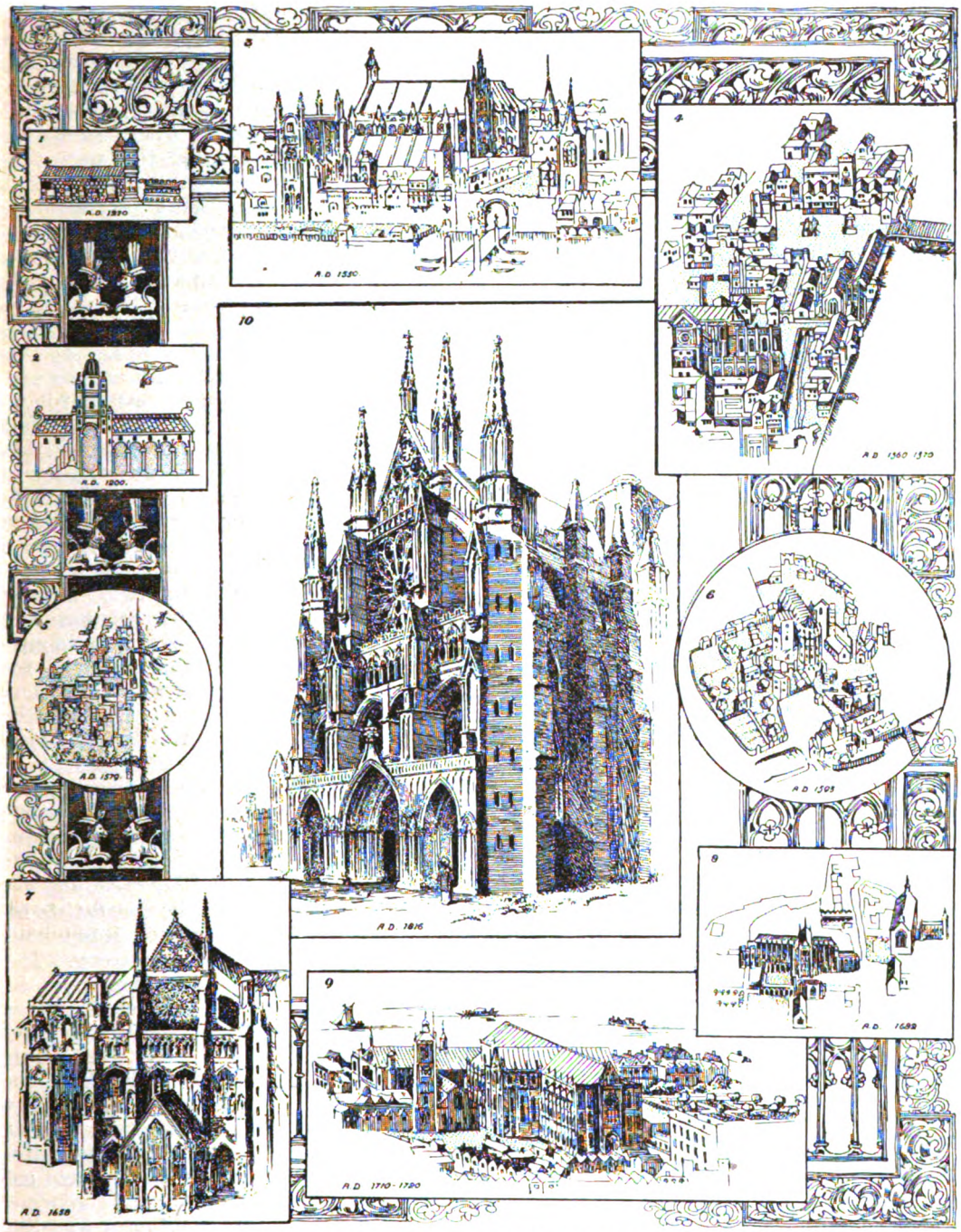
No part of the system of the old Church had been more detested by the Reformers than the honour paid to celibacy. Luther had evinced his own opinion in the clearest manner, by espousing a nun. Some of the most illustrious bishops and priests who had died by fire during the reign of Mary had left wives and children.

Now, however, it began to be rumoured that the old monastic spirit had reappeared in the Church of England; that there was in high quarters a prejudice against married priests; and that even laymen, who called themselves Protestants, had made resolutions of celibacy which almost amounted to vows.

The Lambeth Articles

Nor was this all. A class of questions, as to which the founders of the Anglican Church and the first generation of Puritans had differed little or not at all, began to furnish matter for fierce disputes. The controversies which had divided the Protestant body in its infancy had related almost exclusively to Church government and to ceremonies. There had been no serious quarrel between the contending parties on points of metaphysical theology.

The doctrines held by the chiefs of the hierarchy touching original sin, faith, grace, predestination, and election, were those which are popularly called Calvinistic. Towards the close of Elizabeth's reign her favourite prelate, Archbishop Whitgift, drew up, in concert with the Bishop of London and other theologians, the celebrated instrument known by the name of the Lambeth



WESTMINSTER ABBEY THROUGHOUT THE AGES.

1 *In* **1270**: *From Matthew Paris.* 2. *In* **1200**: *From the picture of a Royal Funeral. Note the Hand of Providence.* 3 *In* **1550**: *From Antony Van der Wyngaerd's "View of London."* 4. *Between* **1560-1570**: *From Ralph Aggas's "Plan of London."* 5. *In* **1579**: *From Braun and Hogenberg's "Map of London."* 6. *In* **1593**: *From the "Speculum Britanniae" of John Norden.* 7. *In* **1658**: *From W. Faithorne's "Map of London.'* 8. *In* **1682**: *From a "Prospect of London and Westminster," by Robert Morden and Philip Lea.* 9. *Between* **1710-1720**: *From John Kip's "View of London and Westminster."* 10. *In* **1816**: *The North Transept, from Neale's "Westminster Abbey."*

According to the legend—a monkish forgery interpolated in a copy of Edgar's Charter—the Abbey Church of St. Peter, Westminster, was mystically consecrated in 616 A.D. by St. Peter himself. The church was rebuilt by Edward the Confessor, and much enlarged by Henry III., Edward I., and Henry VII. The western towers are attributed to Wren's design, but were not begun till twelve years after his death, in 1723.

Articles. In that instrument the most startling of the Calvinistic doctrines are affirmed with a distinctness which would shock many who, in our age, are reputed Calvinists.

One clergyman, who took the opposite side, and spoke harshly of Calvin, was arraigned for his presumption by the University of Cambridge, and escaped punishment only by expressing his firm belief in the tenets of reprobation and final perseverance, and his sorrow for the offence which he had given to pious men by reflecting on the great French reformer.

The school of divinity of which Hooker was the chief occupies a middle place between the school of Cranmer and the school of Laud; and Hooker has, in modern times, been claimed by the Arminians as an ally. Yet Hooker pronounced Calvin to have been a man superior in wisdom to any other divine that France had produced, a man to whom thousands were indebted for the knowledge of divine truth, but who was himself indebted to God alone.

Arminianism

During the reign of Charles I, the name, Arminians, came to be applied almost exclusively to the High Church party in England. Strictly speaking, however, the Arminians were those Dutch Protestants who followed the teaching of Arminius, rather than the more rigid doctrine of Calvin.

The party came into being as a result of the reaction which set in in the minds of many men, at the beginning of the seventeenth century, against what seemed the bigotry of extreme Protestantism. Had not the Reformers—asked the followers of Arminius—in their desire to get rid of the evils of Popery, destroyed much that was valid in Catholic Christianity?

Silenced in Holland, Arminianism took firm root in England, and was welcomed by many who shared in the reaction against Puritanism. A violent controversy ensued between Calvinists and Arminians. James I. attempted to silence it in 1622, but later he did much to revive and intensify it, for, although at one time he had been a firm Calvinist, and although he wrote a book against Vorstius, the successor of Arminius, he himself became converted to the Arminian point of view.

Presbyterians and Puritans alike regarded the spread of Arminianism with much disfavour; and in 1629 the Commons resolved that "whosoever shall bring in innovation in religion, or by favour seek to introduce Popery or Arminianism, should be reputed a capital enemy to the kingdom and commonwealth."

But Arminianism continued to gain influence among the High Churchmen, and the term soon came to be applied to all those who objected both to the Roman and Calvinistic doctrines and theory of Church government, the party finding its warmest champions in Charles I. and Archbishop Laud.

When the Arminian controversy arose in Holland, the English government and the English Church lent strong support to the Calvinistic party. But, even before the meeting of the Dutch synod, that part of the Anglican clergy which was peculiarly hostile to the Calvinistic church government and to the Calvinistic worship had begun to regard with dislike the Calvinistic metaphysics; and this feeling was very naturally strengthened by the gross injustice, insolence, and cruelty of the party which was prevalent at Dort. The Arminian doctrine, a doctrine less austerely logical than that of the early Reformers, but more agreeable to the popular notions of the divine justice and benevolence, spread fast and wide.

The infection soon reached the court. Opinions which, at the time of the accession of James, no clergyman could have avowed without imminent risk of being stripped of his gown, were now the best title to preferment. A divine of that age, who was asked by a simple country gentleman what the Arminians held, answered, with as much truth as wit, that they held all the best bishoprics and deaneries in England.

While the majority of the Anglican clergy quitted, in one direction, the position which they had originally occupied, the majority of the Puritan body departed, in a direction diametrically opposite from the principles and practices of their fathers.

Tyranny of Princes

The persecution which the separatists had undergone had been severe enough to irritate, but not severe enough to destroy. They had been not tamed into submission, but baited into savageness and stubbornness. After the fashion of oppressed sects, they mistook their own vindictive feelings for emotions of piety, encouraged in themselves by reading and meditation a disposition to brood over their wrongs, and, when they had worked themselves up into hating their enemies, imagined that they were only hating the enemies of heaven.

In the New Testament there was little indeed which, even when perverted by the most disingenuous exposition, could seem to countenance the indulgence of malevolent passions. But the Old Testament contained the history of a race selected by God to be witnesses of His unity and ministers of His vengeance, and specially commanded by Him to do many things which, if done without His special command, would have been atrocious crimes. In such a history it was not difficult for fierce and gloomy spirits to

find much that might be distorted to suit their wishes.

They sought for principles of jurisprudence in the Mosaic law, and for precedents to guide their ordinary conduct in the books of Judges and Kings. Their thoughts and discourse ran much on acts which were assuredly not recorded as examples for our imitation. The prophet who hewed in pieces a captive king, the rebel general who gave the blood of a queen to the dogs, the matron who, in defiance of plighted faith, and of the laws of eastern hospitality, drove the nail into the brain of the fugitive ally who had just fed at her board, and who was sleeping under the shadow of her tent, were proposed as models to Christians suffering under the tyranny of princes and prelates.

Morals and manners were subjected to a code resembling that of the synagogue, when the synagogue was in its worst state. The dress, the deportment, the language, the studies, the amusements of the rigid sect were regulated on principles not unlike those of the Pharisees who, proud of their washed hands and broad phylacteries, taunted the Redeemer as a sabbath-breaker and a wine-bibber.

It was a sin to hang garlands on a Maypole, to drink a friend's health, to fly a hawk, to hunt a stag, to play at chess, to wear lovelocks, to put starch into a ruff, to touch the virginals, to read the *Fairy Queen*.

The extreme Puritan was at once known from other men by his gait, his garb, his lank hair, the sour solemnity of his face, the upturned white of his eyes, the nasal twang with which he spoke, and above all, by his peculiar dialect. He employed, on every occasion, the imagery and style of Scripture. Hebraisms violently introduced into the English language, and metaphors borrowed from the boldest lyric poetry of a remote age and country, and applied to the common concerns of English life, were the most striking peculiarities of this cant, which moved, not without cause, the derision both of Prelatists and libertines.

Thus the political and religious schism which had originated in the sixteenth century was, during the first quarter of the seventeenth century, constantly widening. Theories tending to Turkish despotism were in fashion at Whitehall. Theories tending to republicanism were also in favour.

From the portrait by G. Fliccius in the National Portrait Gallery. Photo: Emery Walker.

THOMAS CRANMER (1489–1556),

who became Archbishop of Canterbury in the reign of Henry VIII., was largely responsible for the course taken by the Reformation in England and for the establishment of the Anglican Church. He died a martyr's death in March, 1556.

While the minds of men were in this state, the country, after a peace of many years, at length engaged in a war which required strenuous exertions.

In 1616 Sir Walter Raleigh, the great Elizabethan "pirate," who had been in prison since 1603, on a charge of complicity in plots against the King, was released, and given permission to lead an expedition against Guiana, where he hoped to discover gold. The expedition, however, proved a failure; and Raleigh was put to death in deference to Spanish susceptibilities.

The Thirty Years War

In 1618 the Thirty Years War began in Germany. At the beginning of this struggle public opinion was strongly in favour of intervention. James, however, refused to be dragged into the war.

In 1621 a violent controversy took place in Parliament between the King and the Commons over the question of foreign policy.

The King in anger dissolved Parliament, January, 1622. Negotiations were then set on foot for a marriage between James' son, Prince Charles, and the Spanish Infanta. In order to press his suit, Prince Charles, accompanied by Buckingham, went to Spain in 1623. Buckingham, however, quarrelled with the Spanish ministers, and the match was broken off.

In consequence of this, James suddenly reversed his foreign policy. In March, 1624, he declared war on Spain.

This war hastened the approach of the great constitutional crisis. It was necessary that the King should have a large military force. He could not have such a force without money. He could not legally raise money without the consent of Parliament. It followed, therefore, that he either must administer the government in conformity with the sense of the House of Commons, or must venture on such a violation of the fundamental laws of the land as had been unknown during several centuries.

King or Parliament

The Plantagenets and the Tudors had, it is true, occasionally supplied a deficiency in their revenue by a benevolence or a forced loan; but these expedients were always of a temporary nature. To meet the regular charge of a long war by regular taxation, imposed without the consent of the Estates of the realm, was a course which Henry VIII. himself would not have dared to take. It seemed, therefore, that the decisive hour was approaching, and that the English Parliament would soon either share the fate of the senates of the Continent, or obtain supreme ascendancy in the state.

Just at this conjuncture James died, and Charles I. succeeded to the throne.

From the picture by F. Goodall, R.A.

EPISODE IN THE HAPPIER DAYS OF CHARLES I.

whose reign began under excellent auspices. Above he is shown in a state barge with his Queen, Henrietta Maria, the French King's daughter whom he married five weeks after his accession to the throne.

Continued from page 87.

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Contributors:—ANTHROPOLOGY AND ETHNOLOGY (Sir H. H. Johnston, G.C.M.G., K.C.B.). ASTRONOMY (Arthur R. Hinks, M.A., F.R.S.). BOTANY (E. W. Edmunds, M.A., B.Sc.[Lond.]). CHEMISTRY (E. H. Tripp, Ph.D.). ELECTRICITY AND MAGNETISM (L. M. Parsons, M.Sc., D.I.C., F.G.S.). GEOLOGY AND MINERALOGY (Arthur Holmes, D.Sc. [Lond.], A.R.C.S., D.I.C., F.G.S.). PHYSIOLOGY (Sir Malcolm Morris, K.C.V.O., and D. W. Carmalt-Jones, M.A., M.D.[Oxon.]). SOUND, LIGHT, AND HEAT (E. W. Edmunds, M.A., B.Sc. [Lond.]). ZOOLOGY (E. A. Bryant and Ashley G. Brown, F.Z.S.).

SOUND.—IV

13. Transverse Vibrations of Strings.—THE production of sound in the piano, the harp and the violin and many similar instruments depends upon the vibration of a stretched string or wire, and the laws of this vibration must now be briefly studied. This may be conveniently done on the *monochord* or *sonometer*.

The sonometer is a hollow wooden box on which are stretched two "strings" of pianoforte wire. One of these strings is fixed at both ends, and can be tuned by a wrest pin; the other is fixed at one end only, the other end being carried over a bridge and connected with a scale pan which can be weighted so that the tension or stretch of the string can be varied. There is also a movable bridge, by means of which the length of string vibrating can be adjusted. With this instrument the laws of vibrating strings can be verified.

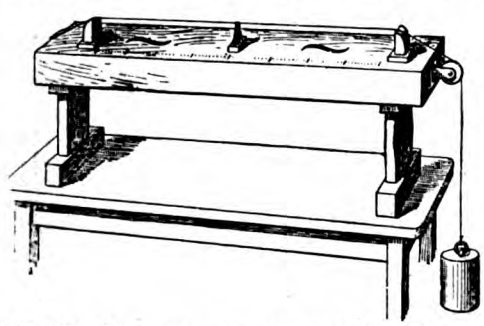


Fig. 26.—The sonometer: a convenient instrument for studying the laws of vibration.

1. Remove the movable bridge to the end of the string, and pluck the string. It now vibrates as a whole, as may be seen by its spindle shape; and the note it gives is constant throughout, so that the pitch does not depend on the amplitude.

2. Tune the two strings so that they are giving out the same note. Then move the bridge to the middle point of the free string. On plucking this, it will be easy to recognise by comparison with the fixed string that we now have the octave of the original note. Hence, the pitch is doubled when we halve the length. Divide the string into three parts by the movable bridge: the shorter half is now giving us the note which is the fifth above the octave, *i.e.* a note whose frequency is three times that of the first note. Further experiment will show that the frequency is always inversely proportional to the length of the string.

3. Again tune the two strings into unison, and try the effect of changing the weights in the scale-pan. It will be found that in order to obtain the octave we must have four times the load. The pitch in fact is proportional to the square root of the tension applied.

4. Two strings of different thickness and the same material do not give the same note, the thicker one being lower. Find in grams the mass of 1 cm. of the string; it will be found that the frequency is inversely proportional to the square root of this quantity. As this mass is itself proportional to the area of section of the wire which in its turn is proportional to the square of the diameter, we have the frequency inversely proportional to the diameter of the wire directly—of course for the same material:—

$$n \propto \frac{1}{\sqrt{m}} \propto \frac{1}{\sqrt{d^2}} \propto \frac{1}{d}.$$

The whole of the variable factors have now been examined. The elasticity of the wire, being a very small part of the restoring force, does not affect the result, except negligibly. The formula which gives the frequency is:—

$$n = \frac{1}{2l}\sqrt{\frac{T}{m}}$$

l being measured in centimetres, m in grams per *cm.* and T in dynes or metric units of force.

Example:—What note will be given out by a string which is stretched by a weight of 4 kilograms, the string being 50 cm. long and 1 cm. of it weighing 0·16 gram?

We have $n = \frac{1}{2l}\sqrt{\frac{T}{m}}$ where $T = 4000 \times 981$ dynes, $l = 50$, $m = 0{\cdot}16$.

$$\text{Hence } n^2 = \frac{1}{10000} \cdot \frac{4000 \times 981}{0{\cdot}16} = 2452{\cdot}5$$

$$\text{or } n = 49{\cdot}5.$$

The note which we hear when a string vibrates, known as its *fundamental tone*, is not a pure note

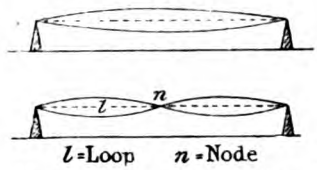


Fig. 27.—If a string be "damped" at its middle point, and then plucked, it will be found to vibrate in two halves.

but is accompanied by one or more subsidiary notes called *overtones*. When the string is vibrating as a whole we hear the fundamental, whose quality is, however, modified by the presence of the overtones along with it. The difference in quality between two notes of the same frequency, made on the violin and the piano, is due to a different admixture of overtones with the fundamental.

The overtones are for the most part *harmonics*

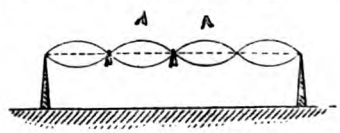


Fig. 28.—The position of nodes and loops may be found by means of V-shaped paper riders which will be thrown off loops but will rest on nodes.

also; that is to say, their frequencies are some exact multiple of the fundamental frequency. Thus along with c = 128, we can almost always detect c = 256; sometimes g = 384, c′ = 512 and even higher tones. In the violin more of the higher harmonics are present than in the piano.

If a string be "damped" at its middle point,

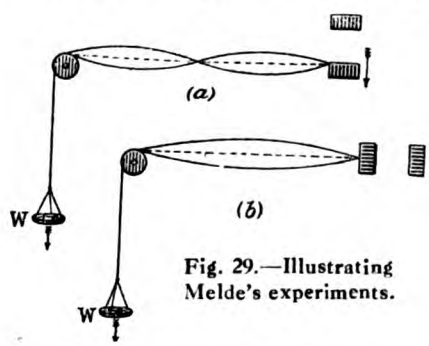


Fig. 29.—Illustrating Melde's experiments.

by resting the finger lightly upon it, and one-half of it be then plucked, the string will be found to vibrate in two halves (Fig. 27), and the octave of the fundamental note will be heard. This is the *first harmonic*. By damping points $\frac{1}{3}$, $\frac{1}{4}$, $\frac{1}{5}$, etc., of the distance from one end we can obtain the other harmonics; and it will be found that the string divides up into a number of vibrating segments corresponding to the point of division. Thus, when the damping is one-quarter of the way from one end, there are four such segments, separated by points of almost complete rest called the *nodes*. The vibrating portions are spoken of as *loops*. To find the positions of nodes and loops, we cut little **V**-shaped riders of paper which will be thrown off the string if placed on a loop but will rest on a node (Fig. 28).

The division of a string into loops is well illustrated in Melde's experiments. The string is fixed to the prong of a vibrating fork and the other end passes over a pulley so that a weight may be hung on it. We can adjust this weight so that the string vibrates as a whole in unison with the vibration of the fork. The unison is, it must be noticed, only true in the case (*a*) (Fig. 29). In (*b*), the string is loosened by a forward motion of the fork and tightened by the

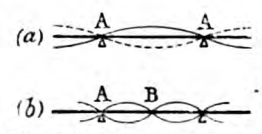


Fig. 30.—Illustrating the fundamental principle of —the harmonicon.

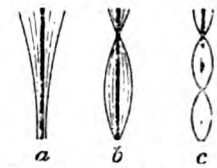
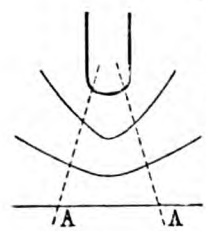


Fig. 31.—the musical box.



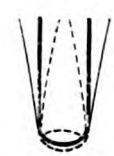


Fig. 32.—of the tuning fork.

backward motion; hence the string only makes one-quarter of a complete vibration while the fork makes one-half. The frequency of the string is thus half that of the fork. In (*a*), the string will vibrate with the fork. In both cases, if we decrease the weight in the pan to one-quarter, the string will divide into two vibrating loops, separated by a node. The reason for the decrease is evident from the formula $n = \frac{1}{2l}\sqrt{\frac{T}{m}}$. Here n and m are constants, n being the frequency of the fork; hence $l \propto \sqrt{T}$ or $l^2 \propto T$, and if l is doubled, T must increase fourfold, and vice versa.

The presence of overtones can be easily recognised by anyone with a very moderate sense of sound on the piano. Strike any note, say *c*, so as to accustom the ear to the sound. Then holding the key down, strike firmly the octave below it. The note *c* can then be well heard. Similarly the *g* next above can often be perceived. These are the first and second harmonics.

14. Vibration of Rods.—The vibration of a rod is a more complex matter than that of a string owing to the entrance of the elastic constants into the question. Three forms of vibration are possible. The rod may be made to undergo transverse, longitudinal or torsional vibrations.

In the first case the rod may be fixed at both ends, fixed at one end or free at both ends, and each form demands special mention.

The musical box is an example of an instrument in which the notes are obtained from rods fixed at one end. The essential part is a steel comb whose teeth are of different length and consequently give different notes. The fundamental note is produced when the rod vibrates as a whole (Fig. 31*a*): the first harmonic has a frequency six and a quarter times that of the fundamental, and in order to obtain it, the rod must be damped with the

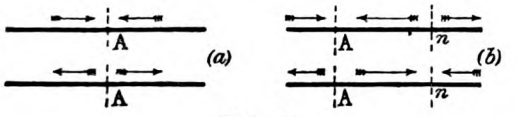


Fig. 33.

finger and thumb about one-fifth the length from the top (Fig. 31*b*). For the second harmonic we have two nodes, but the rod is not divided symmetrically by the vibrating segments. Of course the time of vibration depends on the length and area of the rod; but the relation is too complicated to work out here. Equally it should be noted that the modes of vibration represented in Fig. 31 are not truly a harmonic series, though we have spoken of the notes yielded as harmonics.

A rod free at both ends and supported at two symmetrical points is used in the toy-instrument, the harmonicon. The mode of vibration is indicated in Fig. 30*a*. New nodes may be developed between the points of support: in Fig. 30*b* there is a node at B midway between A A. The frequencies rise according to the squares of the odd numbers, beginning with 3: with the number of nodes 2, 3 and 4 respectively, we have frequencies as $3^2 : 5^2 : 7^2$.

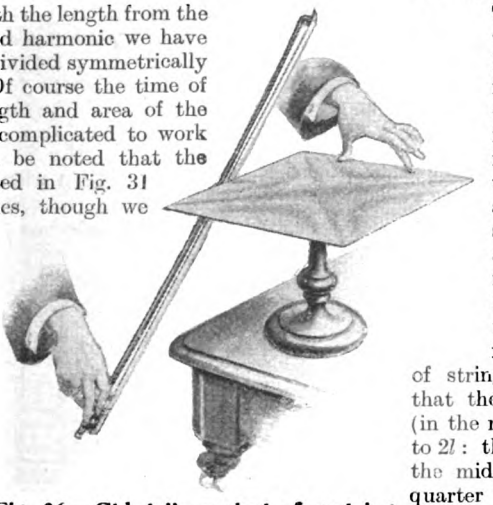


Fig. 36.—Chladni's method of studying the vibration of plates.

The tuning-fork may be regarded as an example of a rod free at both ends, which has been bent as suggested by Fig. 32, the angular points being the nodes. Or it may be regarded as a compound of two rods fixed at one end. It gives a very pure fundamental tone; its overtones are very high—the first being six and a quarter times the frequency of the fundamental—and die out very rapidly. Mounted on a suitable resounding box, it is purged still more completely of its overtones. No better standard of pitch could be chosen.

Both rods and wires can be made to vibrate longitudinally. Hold a glass or metal rod at its middle point, and rub one-half of it with a resined duster. After a few trials a high note is emitted, resulting from the longitudinal vibration of the rod. The rod is elongated by the pull exerted on it, and recovers itself by virtue of its elasticity, and under the same influence shortens and elongates alternately. The frequency of the note depends on the rate at which the pulse travels along the rod, i.e. upon the velocity of sound in the rod. To give a note of pitch 1,000, the wave must travel up and down the rod 1,000 times a second. If v = velocity of sound in the rod, t = time of each vibration, and l the length of the rod, we have

$$vt = 2l.$$

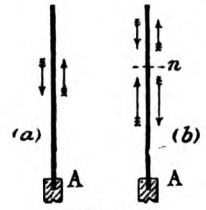


Fig. 34.

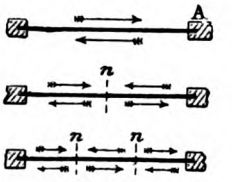


Fig. 35.

But $t = \frac{1}{n}$, where n is the frequency of the note.

Hence, $v = 2l.n$.

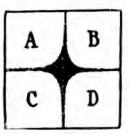
The frequency is thus inversely proportional to the length of the rod. The first harmonic which is the octave of the fundamental is produced when the rod is clamped one-quarter of the distance from one end, and the shorter arm stroked. A node develops also at the same distance from the other end (Fig. 35). The free end of the rod corresponds to a loop in the transverse vibration of strings, from which we realise that the wave-length of the note (in the rod, not in the air) is equal to $2l$: the distance from a node to the middle of a loop being one-quarter of a complete wave. If we could measure accurately the pitch of the note emitted, we could thus calculate easily the velocity of sound in the solid; but the note is too high for its pitch to be satisfactorily measured, and the method of Kundt described in our next lesson gets over the difficulty. The sound obtained in these vibrations is also one of great intensity, often great enough to shatter glass-rods.

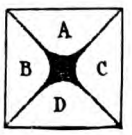
If the rod is fixed at one end, the fixed end is the node, and the free end a loop or *antinode*. The wave-length in the material $= 4l$. In the second mode of vibration a node is formed at a point $\frac{1}{5}l$ from the free end; it then vibrates as shown in Fig. 34*b*, with a frequency three times that of the fundamental note.

When the rod is fixed at both ends, the wave-length $= 2l$. The first harmonic is produced with an additional node at the centre; it is the octave of the fundamental note. The second harmonic divides the rod into three equal parts with frequency a fifth above the octave, the frequencies being inversely proportional to the length of rod between the nodes.

15. Vibration of Plates and Bells.—The vibrations of flat plates, square or round, have

only small musical importance in connexion with gongs and bells. The theory is very difficult, but practically they can be conveniently studied by the method of Chladni. The plate is supported firmly at its centre, and set into vibration with a bow (Fig. 36). At the same time the observer damps the plate at one or more points with his fingers; these points determine the position of the nodal lines, and fix the method of vibration. The presence of the nodal lines is indicated by sprinkling a little fine sand on the plate: this is tossed to the places of rest very quickly. A few examples of Chladni's figures are shown in Fig. 37. It should be noticed that two adjacent vibrating segments are vibrating in opposite directions at the same instant. If A is rising, B and C will be falling and D rising. One result of this is considerable interference, as may be shown by holding a card over the segment B, when the sound is heard more loudly: the rarefaction from B is prevented from partially annulling the compression from A immediately above the plate.





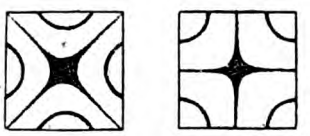


Fig. 37.—Examples of Chladni's figures.

With a circular plate, the nodal lines are along the diameters, if the point damped is on the circumference. But by supporting the circle, either entirely or in part, on two or three fingers within the circumference, circular nodes are produced.

A bell may be treated as if it were a circular plate with nodal lines along the diameters. But this does not explain the complicated overtones that we find in a bell. When the fundamental tone is given, we have four nodes, as at A B C D (Fig. 38), and four loops with centres at *a b c d* vibrating to and from the centre—i.e. along the radius of the circle. Now when the bell is in the position represented in the figure, it is clear that A*b*B is less than B*c*C, and that after half a vibration this will be reversed. From this fact we draw the inference that the node B is not fixed, but moves to and fro along the tangent at B: and similarly with the other nodes.

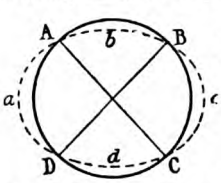


Fig. 38.—Explaining the complicated overtones found in a bell.

There is therefore a tangential vibration as well as a radial one at work in the bell; and this tangential vibration is of the same nature as the longitudinal vibrations of a rod, giving a high note which has no relation to the fundamental note of the bell.

These longitudinal vibrations can be developed in a wine-glass by drawing a damp finger round its edge, but in this case also we must have the radial vibrations too.

E. W. E.

ELECTRICITY AND MAGNETISM.—XV

Chemical Effects of Electric Currents.—In an electric cell chemical work produces a current of electricity. The converse case, in which electricity enables certain electro-chemical changes to take place, will now claim our attention. It was pointed out in an earlier lesson that some liquids act as conductors of current electricity. These liquids include mercury, other metals in the molten condition, certain acid solutions, and solutions containing substances, chemically named salts, dissolved in water. Ordinary water, mineral oils, solutions of such substances as sugar, etc., do not conduct electricity, though it must be mentioned that in the case of water, electricity at a high voltage is conducted by it, as, for instance, when a person receives an electric shock on endeavouring to take a coin out of a bowl of water connected to a medical coil. A current will be conducted by mercury and molten metals without these substances undergoing any chemical change, but the case is different when the current is sent through solutions containing certain salts or acids.

Any solution which conducts an electric current and undergoes certain chemical changes in the process is called an *electrolyte*, a term derived from

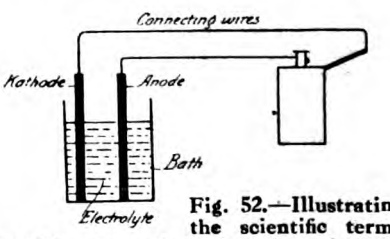


Fig. 52.—Illustrating the scientific terms used in connection with electrolysis.

Greek words denoting "separation by electricity." The process of separating metallic or other substances from solutions by an electric current is known as *Electrolysis*, a name derived from the same Greek roots.

It is well to understand other terms used in connection with electrolysis from the commencement. The electrolyte, or solution to be operated upon, is usually put in a glass trough, which, together with its liquid contents, is technically known as the "bath." The current must be led in and then out of the solution by some conducting material. These conductors are called *electrodes*, but each has a special name, that which conducts the current into the bath being termed the *anode*, and that which conducts it out of the bath is called the *kathode*.

The materials composing the electrolyte, anode and kathode, will depend upon the nature of the electrolytic operation in which they are used. A list stating the kind of electrolytes and electrodes to be used for certain purposes will be given later, but for the present an experiment will help us to understand the process of electrolytic separation.

Experiment 47.—*To obtain copper from a solution of copper sulphate by electrolysis.*

Procure a small quantity, say a few pence worth, of copper sulphate, a substance commonly known as blue vitriol by plumbers, ironmongers, and colourmen who sell it. Break the crystals up, dissolve the material in about one pint of warm water and let the solution stand for some time so that any undissolved solid may settle at the bottom. The solution should be made in some vessel that need not be used for other than experimental purposes. Pour about half a pint of the solution into a glass or glazed earthenware jar. Add a very

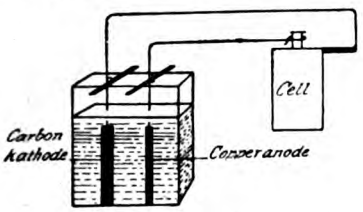


Fig. 53.—To obtain copper from a solution of copper sulphate by electrolysis.

small quantity of dilute sulphuric acid solution. The jar and its contents now form the "bath." Clean the piece of copper used in the construction of your simple cell, connect it to the positive (i.e. carbon) plate of a dry cell, and immerse it in the bath. It is the anode. By means of another connecting wire join the negative or zinc plate of the cell to a piece of clean carbon which may be part of a positive plate of a used-up cell or a piece of carbon formerly used in an electric arc lamp. The carbon, which is the kathode, should now be immersed in the bath opposite, but not touching, the copper plate or anode.

Directly the carbon comes in contact with the liquid the circuit is complete, since the solution in the bath is a conductor. Allow the current to flow for about five minutes, then lift the carbon out of the bath. A fine reddish deposit of metallic copper should now be apparent on the carbon. If this is not the case the cell is probably too weak, and the voltage should be improved by the use of two cells joined in series. Again immerse the carbon and allow it to remain in the bath for another ten minutes or quarter of an hour. Finally withdraw the kathode and allow the deposit of copper on it to dry.

In performing this experiment, an old teaspoon or fork could be used in the place of the piece of carbon, but in that case care must be exercised to see that the object is clean and free from traces of grease, so that the deposit of copper may have a proper chance of settling. The result of the experiment may be stated simply by our saying that the carbon has been copper plated.

Dissociation and Ions.—Let us now consider how has the electric current helped to produce this result? Copper contained in the solution (electrolyte) has been deposited on the carbon (kathode) and a similar proportion of the copper plate (anode) has gone into the solution to replace that adhering to the piece of carbon. *It could be proved by weighing that the amount of copper gained by the carbon is equal to that lost by the copper plate,* hence the solution remains constant as far as its amount of copper is concerned. The student is already familiar with the term molecule, and knows that a molecule of copper sulphate contains copper, sulphur, and oxygen in the proportions represented by the formula $CuSO_4$. In the solution forming the bath there must be millions of copper sulphate molecules, and it is supposed that some of these molecules have already undergone dissociation, that is, split up into their Cu and SO_4 parts in the solution before the electrodes are introduced into it. The Cu and SO_4 parts dissociated in this way are charged with electricity and are called *Ions.*

All metallic ions, such as the Cu in our experiment, are electrified positively, so also is hydrogen when it is an ion in an acid solution, but groups of elements like SO_4 and elements like oxygen are charged negatively. (Refer to theories of Electricity in Lesson I.) Now, when the copper plate and carbon are placed in the bath, the copper, being the positive electrode or anode, attracts the negative SO_4 ions, with the result that fresh copper sulphate is there formed as the positive Cu ions adhere to the negative electrode or kathode by which they are attracted. For every ion of copper that adheres to the carbon kathode, an SO_4 group forms a new molecule of copper sulphate by chemical combination with the copper anode. Stated briefly, the result of electrolysis consists in causing *a general drift of positive copper ions on to the kathode, and a similar drift of an equivalent number of SO_4 groups to the anode* (Fig. 54).

The current is kept going in the bath by the drift of the ions. In the electrolytic method of plating any article with a fine layer of metal, the article to be plated always forms the kathode of the arrangement, since it is to receive the positive metallic ions which will drift to it. *Metals and hydrogen*

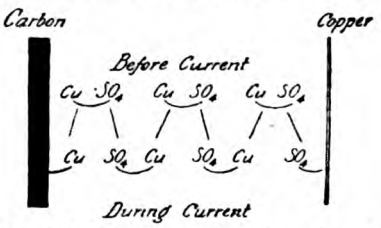


Fig. 54.—Demonstrating the action of electrolysis.

always go to the kathode. The list given below will serve to indicate the nature of the electrolyte and anode used when objects are being plated with any particular metal:—

Metal or Positive Ion	*Electrolyte*	*Anode*
Gold	Double cyanide of gold and potassium	Gold
Silver	Double cyanide of silver and potassium	Silver
Nickel	Nickel sulphate, ammonium sulphate and potassium cyanide	Nickel
Copper	Copper sulphate	Copper
Iron	Ferrous-ammonium sulphate	Iron
Zinc	Zinc sulphate	Zinc

Hints on Plating, etc. This list, on page 137, is given for purposes of information only, and a word of caution is necessary in case the reader should be tempted to try his hand at silver-plating or plating with any other metal requiring a bath containing a cyanide. *These compounds are highly poisonous, potassium cyanide especially.* On no account should a person unaccustomed to performing chemical operations attempt to use solutions containing these salts. Silver nitrate may be used for silver-plating, but it must be made up with distilled water, otherwise a cloudy substance will appear in the solution.

Copper-plating is perhaps the easiest electrolytic operation to perform, but if iron is the metal to be covered, then the copper sulphate solution will not do for the electrolyte.

Experiment 48.—*To note the chemical reaction between iron and copper sulphate solution.*

Dip an iron or steel nail into some solution of copper sulphate, hold it there for a minute or two, then withdraw it. The nail is coated with fine copper.

Iron combines with the SO_4 part of copper sulphate and turns out copper which deposits itself on the iron.

The correct solution to use for the copper plating of iron is a mixture of copper sulphate, tartaric acid, and sodium hydrate. A particular application of copper-plating is the process of covering wooden blocks used in printing illustrations with a fine layer of copper. The wooden blocks themselves would soon wear out, but covered with copper they may be used to print many thousands of copies. Wood being a non-conductor, it must be covered with a fine layer of silver sulphide or graphite so that it may act as a kathode.

When plating metallic objects such as spoons and forks with silver, gold, etc., it is very necessary to cleanse them thoroughly, and this is done by immersing them in alkaline solutions and then in weak acid solutions.

The voltage required for plating in metals is not very high, but it differs according to the solution used as the electrolyte. In the case of copper sulphate, 1½ volts is high enough, hence if two or more cells are used they may be joined in parallel. With a silver bath, the voltage may be a little less, but when nickel-plating is to be accomplished, an E.M.F. of at least 5 volts should be employed. The amount of any metal deposited on the kathode depends upon the time the current flows, the strength of the current in amperes, and upon the nature of the metal. There is a definite connection between these three factors, and we shall consider the connection in the next lesson. The strength of the current is of some importance, as it determines what is called the density of the deposit per square foot in a certain time. For plating in silver a current of 1·5 amperes per square foot is very suitable, but for copper it should be at least twice as strong, and for nickel about 15 amperes per sq. ft.

In all cases the current must be continuous, and in the same direction, as a reversal of the current would strip the kathode of the deposit previously formed on it.

Experiment 49.—*To electrolyse Potassium Iodide.*

Obtain a few crystals of a white substance called potassium iodide. Dissolve a small portion in a small quantity of water. Put the solution in a vessel and introduce electrodes made of platinum wire or carbon. Platinum wire is better, and as it may be required for later experiments it may be as well to purchase four or five inches. If the wire is thin this length will only cost about one shilling.

The chemist who serves the potassium iodide will also supply the wire. When the electrodes are in solution, the current flows and a brown substance slowly collects round the anode. This substance is iodine freshly liberated from the solution. The iodine is the negative ion in this case.

At the kathode, the metal potassium is liberated, but this attacks the water, forming a soluble substance called caustic potash, while hydrogen bubbles derived from the water collect at the kathode. If a piece of porous paper is dipped into a solution of potassium iodide, and the connecting wires from the terminals of any cell are brought down on the moistened paper about half an inch apart, a brown stain, due to iodine, will indicate the *positive* plate of the cell, and the direction of the current. This test can be applied to wires removed from a source of current, or to accumulators from which the positive mark has disappeared.

L. M. P.

BOTANY.—VIII

23. Work of the Leaf. Photosynthesis.—We have seen that the leaf is an organ morphologically adapted to catch as much light as possible. The reason of this careful adaptation will be evident when we learn that, without light, the most important work of the leaf, and the most vital to the plant, could not be carried on.

If the leaf, or any part of the plant which is normally green, is kept in the dark for some time, the green colour disappears, or does not develop. The interior leaves of a cabbage and the bleached stalks of celery will at once occur to the reader as examples of this. The green substance is known as *chlorophyll*, and is thus dependent on light for its formation.

DEMONSTRATION XXIII

1. Chlorophyll may be dissolved out of a leaf in the following way: Take the leaf of a lime or beech, and heat it for some minutes in boiling water. No chlorophyll dissolves out. Now place the dead leaf in methylated spirits or ether or benzene; the chlorophyll slowly dissolves, leaving the leaf almost colourless. We shall refer to this process as *bleaching* the leaf. The chlorophyll solution is a deep green liquid, with a curious brick-red appearance in reflected light.

2. If a leaf which has been thus bleached is placed in iodine diluted with methylated spirit, it will often show by the blue colour the presence of starch. It is useless to perform this test with the unbleached leaf.

The condition under which starch is formed

is found to be the presence of light. A leaf taken from the tree at the end of a day shows an abundance of starch ; if it be taken in early morning, it shows little or none. If a strip of tinfoil be placed over the leaf, no starch is formed in the part of the leaf thus shielded from the light (Fig. 52). And again, if a variegated leaf is tested, we find that starch forms only in the green parts, and not at all in the other parts of the leaf. Thus starch is formed somehow in green leaves, by the influence of chlorophyll in the presence of light. This is the process now spoken of as *photosynthesis*, sometimes as *carbon-assimilation*.

Fig. 52.—To prove that light causes the formation of starch in a leaf.

The latter term does remind us of the essential point in the starch manufacture. Starch is a complex compound of carbon, hydrogen and oxygen ($C_6H_{10}O_5$). We are entitled to ask how, and from what materials, this complex substance is manufactured. The last question only can be satisfactorily answered ; more or less likely theories alone have been brought forward in reply to "Madame How."

The source of the hydrogen and oxygen is, undoubtedly, the water taken in by the root ; the source of the carbon is not so immediately evident. It was natural, in the early days of Botany, to suppose that the organic matter in the soil, so vital to plant growth, should be the source of carbon, the most important element in the plant's composition. But a plant will produce starch in undiminished amount when grown in a soil absolutely free from carbon. The student can easily test this for himself by growing some seedlings in pure sand fertilised by the culture - solution described in Lesson VI. No carbon can possibly be obtained from the ground, and if well boiled water has been used for watering the plant, no carbon can occur in the water in any form. There remains only the air as the possible source of carbon for the synthesis of starch.

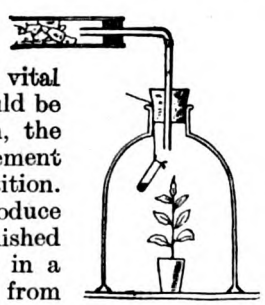


Fig. 53.—To show that a plant which cannot obtain carbon from the air cannot make starch.

The only carbon-containing compound of carbon in the air is carbonic acid gas, or carbon dioxide (CO_2), which is always there, owing to its continued production by the breathing of animals, by combustion and decay. Now, in normal air, the amount of carbon dioxide is rarely more than 4 parts in 10,000 ; and on the average this small proportion is not exceeded. It is evident that there must be some process at work to keep it down to this : otherwise the amount of carbon dioxide accumulated in the air would make it unbreathable, as it is, for instance, at the bottom of a dry well. It is not difficult to conclude then that the carbon dioxide of the air is a likely source of the carbon which is needed to manufacture starch. To clinch the point we have only to test the leaves of a plant growing in air from which carbon dioxide has been removed. Under these conditions we find that no starch is formed.

3. Carbon dioxide is readily absorbed by alkalis such as lime, potash, or soda ; hence air which is drawn through a tube containing one or other of these will be free from it. Take a plant in a small pot and cover it completely with a bell-jar provided with a tube leading into a U-tube containing loose pieces of soda-lime. Hang up a small tube containing potash in the bell-jar, as shown in Fig. 53. Place the bell-jar on a board, having first covered its edges with vaseline to prevent air from entering from below. Expose the whole to the light, and after a few hours test a leaf for starch as in Exp. 1.

The result of such an experiment is conclusive : if a plant cannot obtain carbon from the air, it cannot make starch at all, and this failure would be in the end fatal to it, as Exp. 3 would show. But carbon dioxide contains oxygen as well as carbon ; and analysis of starch (expressed in its formula) shows that this oxygen is not necessary to it, sufficient oxygen being supplied by the water ($C_6H_{10}O_5 = 6C + 5H_2O$). The next question to be asked therefore is this : is the superfluous oxygen returned to the air ?—or is it in any way used by the plant ? Simple experiments again supply the answer.

Fig. 54. — To prove that a plant returns superfluous oxygen to the air.

4. Enclose some air in a bell-jar over water, the bell-jar being fitted with a cork and a delivery-tube as suggested in Fig. 54. At the end of the delivery-tube is a piece of india-rubber tubing *x*. By applying the mouth at *x* inhale and exhale the air in the bell-jar several times. The air in the jar will

now extinguish a light because it is deficient in oxygen. Fix a sprig of mint under the jar, and having performed the inhalation and exhalation as before, tie the rubber tube *x* so that the outside air cannot enter, and leave the jar in open daylight for several days. Then open the cork and note that the air in the jar does not now extinguish a lighted taper. Hence oxygen has been restored to it.

5. The oxygen given off can be directly collected from plants whose leaves will thrive in water. The best plants for the purpose are true water-plants like the Canadian pondweed (*Elodea*), but the leaves of lettuce or watercress answer fairly well. Fit a bunch of watercress in a funnel as shown in Fig. 55, so that the gas given off is collected in the test-tube *t*. Expose to the light, and observe that a gas does collect in the test-tube. When you have enough, test the gas for oxygen with a glowing splinter.

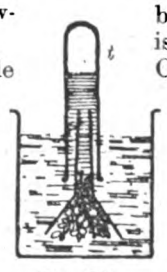


Fig. 55.—To collect the oxygen given off by watercress.

The plant in using the carbon dioxide of the air and returning oxygen to it thus maintains the air in a fit condition for the respiration of man: in fact, a remarkable balance is kept up between the two processes. As we have previously seen, however, the plant also respires; and in respiration it uses oxygen and produces carbon dioxide, just as animals do. But during the daytime the process of respiration is completely masked by the much larger process of photosynthesis. Moreover, photosynthesis is essentially the opposite of respiration in other ways also. It is a feeding process, not a destructive one; it does not produce energy, but requires it.

Carbon dioxide is what chemists call a stable substance; much energy is required to decompose it, and on the other hand much energy is liberated when it is made. This energy appears in the heat of a coal fire, for example. In photosynthesis, it is the function of the light to supply the energy necessary for the decomposition of the carbon dioxide. Without this energy, it would be impossible to "fix" carbon in the plant; no living plants would be possible; and hence it is true that life depends upon sunlight for its existence. The sun's energy is stored potentially in the plant-substances, so that, when we burn wood or coal, we are only liberating in the form of heat the light-energy obtained by plants.

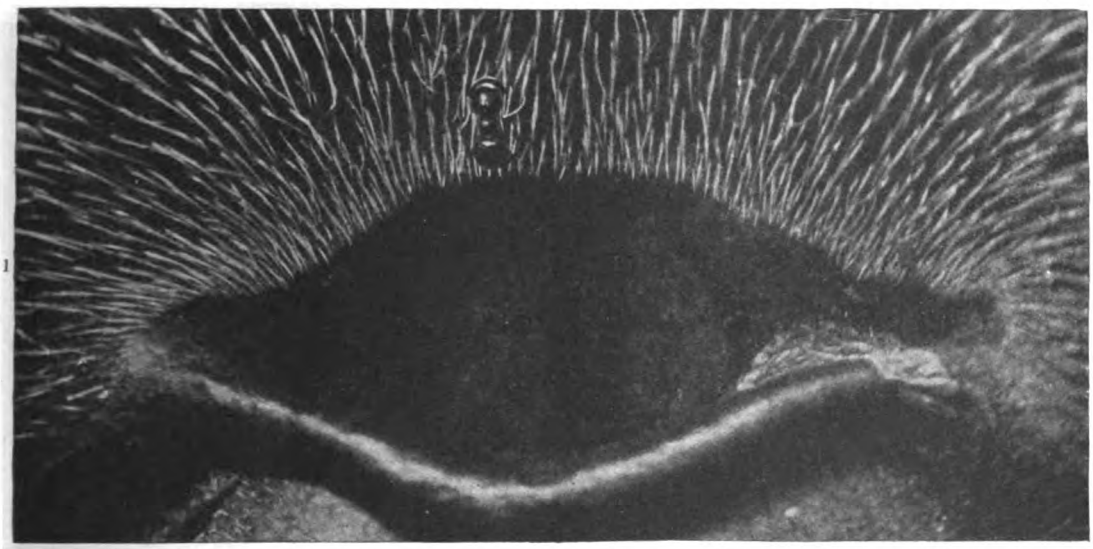
6. Take three wooden boxes large enough to hold a small flower-pot, and cover them with sheets of red, yellow, and blue glass respectively, instead of a lid. In this way you can study the effect of lights of different colours on the process of photosynthesis. It will be found that the blue glass prevents the starch-formation completely; the red glass also stops it more or less completely; but under the yellow glass the starch is formed perfectly well. It is therefore the yellow rays of the sun's light that are the active ones in photosynthesis, and these are precisely the rays that are most absorbed by chlorophyll. This experiment shows us that the fundamental chemical process of plant-life is not merely dependent upon light, but upon a very special part of light, for the energy required by it.

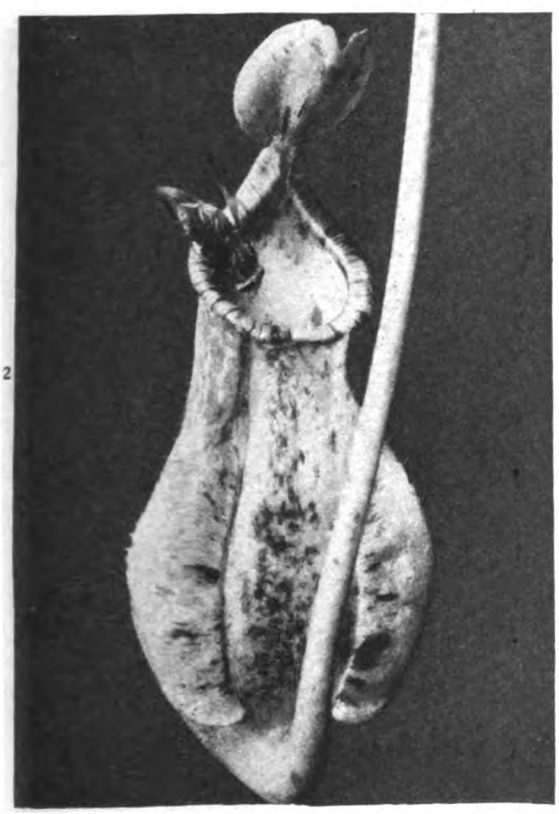
We can represent the final result of photosynthesis in the simple chemical equation—

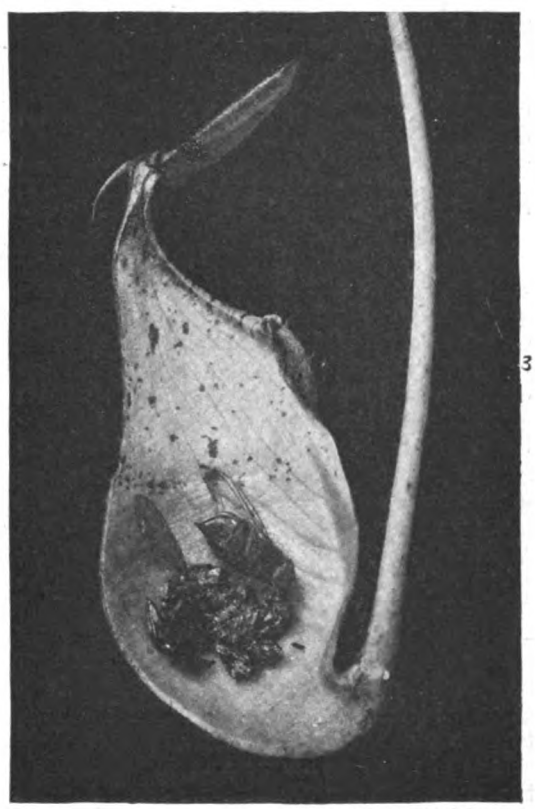
$$6CO_2 + 5H_2O = C_6H_{10}O_5 + 6O_2$$

but the action certainly is more complex than this suggests. There are intermediate steps in the process, but we have no certain knowledge of them, and it would not be profitable to discuss them here. It is probable that grape-sugar ($C_6H_{12}O_6$) is formed before starch; it is certain that the starch disappears from the leaf in the form of grape-sugar, formed by diastase, or a similar enzyme, as in seeds. The presence of grape-sugar is not always easy to detect; but the leaves of a plant which has been kept two or three hours in the dark, sometimes give a solution containing grape-sugar, when they are well boiled in water. Grape-sugar, being soluble, is easily conveyed to the different parts of the plant, and is absolutely essential as the fundamental food of living protoplasm. Nothing certain is known of the method by which grape-sugar helps the nitrates, phosphates and sulphates to make the more complicated proteins. All that we can say definitely about the normal nutrition of a plant is that grape-sugar results from the process of photosynthesis going on in the leaves, and that proteins are formed in all the living parts from the grape-sugar, nitrates, etc., supplied. The plant, from inorganic materials alone, is able to make the necessary proteins and carbohydrates which the animal needs to have ready-made. The plant lives on certain constituents of air, water and soil which it is able to organise into living substance. The synthesis of starch in the presence of light is the first step in this organisation.

24. Insectivorous Plants.—The nutritive processes of plants are thus fundamentally different from those of animals; they cannot digest proteins and carbohydrates, as animals do, but have to manufacture them. A common plant in boggy districts is the *sundew* (Plate facing p. 121). It has a rosette of light green leaves which have a reddish tinge and glisten in the sun.





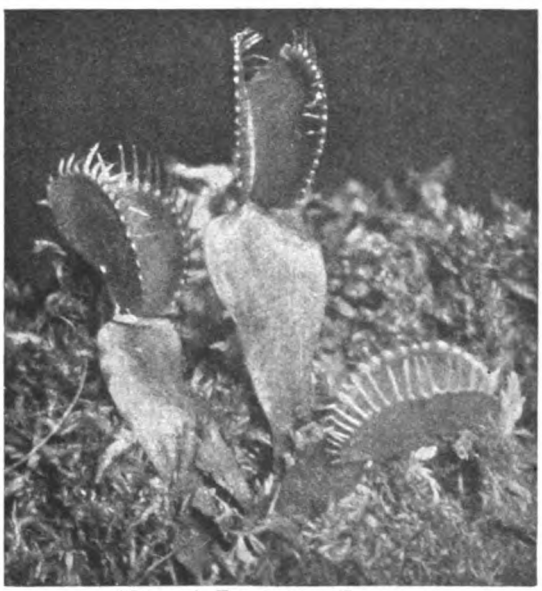


Photos: S. Leonard Bastin.

INSECTIVOROUS PLANTS.

1. Showing an insect vainly endeavouring to escape from the pitcher of a Sarracenia into which it has been tempted by the nectar within, just as the insect in 2 is seen being tempted down the fluted rim of the Nepenthes. Once the insect is inside, as in 3, escape is impossible; the fluid in the pitcher first intoxicates, then digests the intruder.

On examination the leaves will be found covered with coarse hairs, at the end of which drops of shining and sticky juice will be observed. If a small fly settles on the leaf-surface, the hairs tend to bend over and



VENUS' FLYTRAP : OPEN—

A tropical insectivorous plant similar to the sundew but—

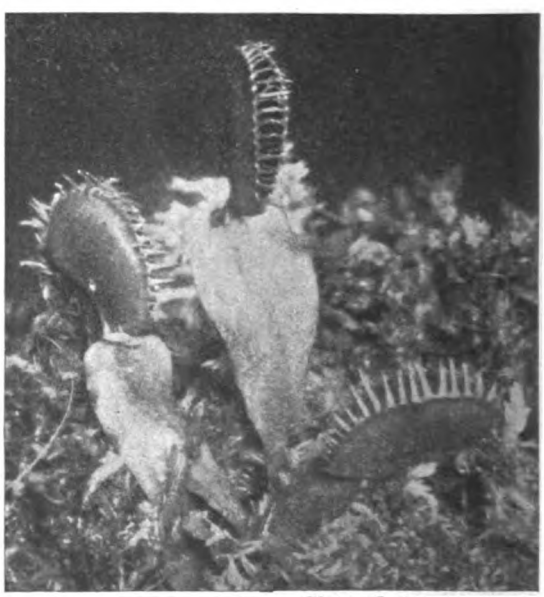
enclose it ; at the same time they secrete a digestive juice containing an enzyme (trypsin) similar to, if not identical with, the trypsin of our pancreatic juice, which renders proteins soluble, and thus makes them available for the plant. After a short time there is nothing left of the fly except the indigestible scales. A small piece of meat is similarly digested by the sundew. This power, obviously, gives the sundew a store of proteins which is not available for ordinary plants. It has probably been evolved in response to the particular needs of the plant in its situation. Though there is plenty of water in boggy ground, it is not always suitable for osmosis ; it is stagnant, it is often acid and is deficient in nitrates ; clearly, then, a plant which can draw upon another source of nitrogen is at an advantage. This the sundew does through its insectivorous habit.

The *butterwort* lives under similar conditions to the sundew. It is a larger plant, but its broadly-lanceolate, light green leaves are formed in a radical rosette growing flat and inconspicuous among the moss. The edges of the leaf tend to coil inward, and their whole surface is rough and glistens with a sticky fluid. Flies are attracted by this ; they settle on the leaves but cannot get off again, and are slowly digested.

Another British insectivorous plant is the *bladderwort* (Plate facing p. 121). This is a water plant, and on the branches of its submerged roots small bladders are developed which act as little traps for water-midges and small insects of the water generally. The bladders have little tufts of hairs at their entrance which effectually prevent an insect's escape.

The tropical flora includes a few more remarkable species of insectivorous plants. *Venus' flytrap* is very similar to our sundew in general appearance and habit. Its leaves, however, are more sensitive ; they fold up along the midrib, whenever a piece of protein is placed upon them.

The *Pitcher-plant* (*Nepenthes*) is still more remarkable. In this plant the lamina of the leaf is completely modified into a pitcher-shaped organ, whose interior surface secretes an abundance of the fluid which first



Photos : S. Leonard Bastin.

—SHUT.

—with very sensitive leaves which quickly fold on a piece of protein.

intoxicates and then digests the intruding insect. The escape of the insect is prevented by the ring of stiff, downward projecting hairs in the neck of the pitcher. The ordinary leaf-functions in this plant are carried out by the expanded and flattened petiole. The *Sarracenias*, common in the bogs of N. America, behave in an imperfect way, like the *Nepenthes*. E. W. E.

ZOOLOGY.—XXIII

THE sub-order *Haplomi* contains a family, the *Esocidæ*, which, since it includes the Pike, is regarded with detestation by every true angler. As an article of diet this fresh-water Shark undoubtedly has its uses, though it is not eaten in these days to the extent it once was, but its voracious character which causes it to destroy enormous quantities of more valuable fish has made it extremely unpopular in every other respect. Its teeth are sharp, numerous, and slope upward towards the throat. The mouth opens to half the length of the head.

Pike and other Esocidæ

Except during the pairing season, the Pike is a solitary fish, a fact which is partly explained by its habit of eating the smaller members of its own family. Its appetite, indeed, knows no limits, and it will generally kill out any other fish unfortunate enough to share its waters. The length and weight of the Pike depend largely upon the amount of food it is able to secure; Pike attaining a weight of thirty pounds are rare in Britain, though a specimen of thirty-seven pounds is said to have been taken near Amersham in 1879.

A curious member of this sub-order is the Blind-Fish or Cave-Fish which haunts the mammoth cave of Kentucky. As its name suggests, this fish by long seclusion from the light has become totally blind, the eyes now being overlain by skin. The place of sight is taken by a peculiar acuteness of touch.

A well-known member of the sub-order *Gastrosteiformes* is the Three-Spined Stickleback which takes its name from the three short spines in front of its dorsal fin. This greedy and active little fish is found in great numbers in all fresh waters where it eats the spawn and prey of its larger and more valuable companions. It does not hesitate to attack fish much greater than itself, and not infrequently has the best of the argument with a Pike, since that unprincipled buccaneer having secured his small adversary in his mouth will generally eject him on account of his spines. The duty of preserving the race, usually undertaken by the female of the species, is in the case of the Stickleback jealously performed by the male, who guards his small nest against all comers. Should he by any chance be placed *hors de combat* in such circumstances, the nest is immediately rifled and the eggs eaten, as often as not by the female Stickleback.

The Ten-Spined Stickleback, also a fresh-water fish, is less common than the Three-Spined variety. The Fifteen-Spined Stickleback is a marine fish to be met with on all the northern coasts of Europe. It is from five to seven inches long, and makes its nest of seaweed or coralline. Its habits are very similar to those of the fresh-water species.

The Pipe Fishes of the family *Syngnathidæ* are marine species of which some enter fresh water. The two divisions into which the family has been split are known to most people as the Pipe Fishes and the Sea-Horses. The five genera comprising the latter division are exceedingly remarkable owing to the peculiar resemblance borne by them to the four-legged animals after which they have been named. But the entire family is unusual in the sense that it is the male fish which performs the office of hatching out the young. This he does by carrying the eggs with him either in pouches on his body or embedded in the loose skin of the abdomen. The snout of the Pipe-Fish is tube-like, and the tail is prehensile in some species, but not in all. All the *Syngnathidæ* are poor swimmers, and are carried passively by currents.

The Sea-Horse, of strange appearance, is one of a genus found in the open seas in all temperate and tropical regions. This particular species is occasionally taken off the British coast, when its odd, horse-like head invariably attracts attention. The tail is prehensile, and by its aid the Sea-Horse attaches itself to seaweed or other floating substance with which it drifts.

Mullet and Gar-Fish

The sub-order *Mugiliformes* or *Percesoces* includes a number of species in which the pelvic fins, when they are to be found, are abdominal and consist usually of one spine and five soft rays. An exceedingly important species in this group is the Common Grey Mullet, which is to be found off practically all the coasts of Europe and as far south as the Cape of Good Hope. Its mouth, which is blunt and nearly toothless, is well adapted to its requirements, for the Mullet feeds on the sea bottom. Though the Mullet frequently enters rivers it returns with the tide; it will, however, thrive quite well if confined in fresh water.

The Gar-Fish is a species widely distributed in European waters and occasionally taken off Britain. The British species, which attains a length of about two feet, is fortunately less dangerous than the larger species to be encountered in the tropics. The jaws

of this fish, which are unduly prolonged, have been compared to a beak in shape.

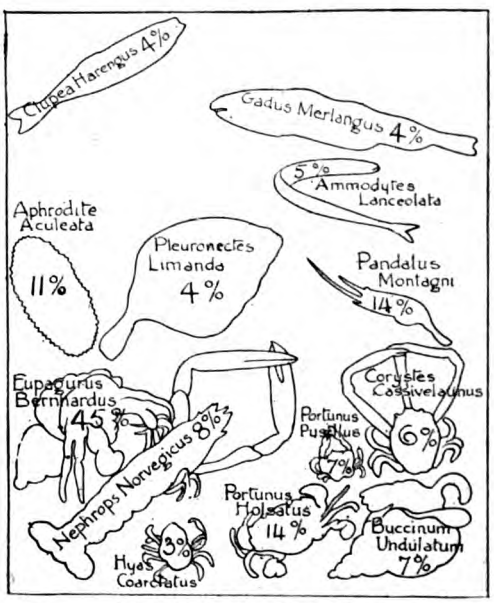
The Climbing Perch, a native of the South of Asia and Africa, gains its name from a reputed ability to climb trees. However that may be, it is able to make its way over rough ground with considerable speed. Its method of progressing is thus described by Dr. Ridewood: "The fish holds on to the ground by the opercular spines, bends its tail and inserts its anal spines; it then straightens the body and causes the opercular spines to move forward over the ground." Upon its land journeys, usually undertaken in search of water, the Climbing Perch is enabled by special organs to breathe through its mouth. When in the water the gills are, of course, used in the customary way.

The Flying Fish are enabled to maintain themselves for a short time above the surface of the water by means of their pectoral fins which are considerably enlarged. The precise extent to which the fish actually "flies," however, is a debatable point. While scientists argue that the pectoral fins perform services no more intricate than those of the parachute, observers who have given some attention to the matter are persuaded that to a limited extent they are used by the fish to increase the height at which he is moving and also to change the direction of his flight.

The original impulse which causes the fish to leave the water is no doubt supplied by the tail. The species occasionally seen off the British coast is the *Exocœtus volitans*, a fish about ten inches in length. The *Barracudas* are fierce fish of considerable size and armed with powerful teeth. They are widely distributed in temperate and tropical seas where some species, such as the *Sphyræna commersonii*, which attains six feet in length, not infrequently attack human beings.

The sub-order *Gadiformes* includes that useful food fish the Cod and its allies under the family title of *Gadidæ*. These fish for the most part inhabit northern latitudes, and several species are taken off the British shore. The Cod hardly needs an introduction to Englishmen. The quantity of Cod landed annually at British ports naturally varies, but 2,000,000 cwts. representing a value of £1,000,000 is not an excessive estimate.

Individual fish run generally from two to four feet in length and turn the scales at about twenty pounds. The natural feeding ground of the Cod is some slight elevation upon the sea bottom. The greatest fisheries are those of the Dogger Bank, those off the banks of Newfoundland and those off the Icelandic coast. In view of the extent to which the Cod is fished, it is fortunate that he is amongst the most prolific of fishes. In the roe of a thirty-pounder the number of eggs was estimated to exceed the prodigious total of 7,000,000. The Newfoundland fisheries appear to secure the largest fish, a few specimens taken there reaching a hundredweight.



FOOD OF THE COD FISH.
Key to the drawing reproduced opposite.

The Haddock, a migratory fish taken in great numbers round the British coast and off the American shores of the North Atlantic, is distinguished from the Cod by a black lateral line upon each side and by a dark patch above each pectoral fin. The head is relatively smaller than that of the Cod, and the barbel is less developed.

The Whiting is abundant in shallow waters from off the coast of Northern and Western Europe. Its usual size is from twelve to sixteen inches. The Pollack frequents deeper water with a rocky bottom. The Hake is one of the commoner British fishes, being taken in large quantities off the coast of Devon and Cornwall. It is said that when Hake congregate in any numbers, Pilchards and Herrings are approaching the coast. Crouch records that in one instance no fewer than seventeen Pilchards were taken from the stomach of one Hake of ordinary size.

A. B.

Drawn by A. Hugh Fisher.

A VARIED MENU.

The creatures upon which the cod fish in the southern waters of the North Sea mainly feed— *see key opposite.* **Crustaceans have been found in 83 per cent. of the stomachs examined; fishes in 35 per cent.; polychaete worms in 16 per cent.; and mollusca in 9 per cent.**

ANATOMY AND PHYSIOLOGY. V

We spoke in the first lesson of the " girdles " to which the limbs are attached. The " pectoral " girdle (pectus means breast) consists of two bones on each side, the collar-bone, or clavicle, in front, and the shoulder-blade, or scapula, behind.

The collar-bone (clavicle) is a flat bone, slightly curved like an S. It lies in front of the first rib. Its inner end is jointed on to the top of the sternum and its outer end reaches to the shoulder.

The shoulder-blade is a flat triangular plate of bone which lies on the outer part of the back and covers the back and outer part of the upper ribs. Its longest border is parallel to the spine, and the corner opposite to this border forms part of the shoulder joint. There is a ridge of bone on its outer side called the *spine of the scapula*, the top of which forms the point of the shoulder. The collar-bone is jointed on to the end of the spine of the scapula. Below the collar-bone there is a hook of bone on the scapula, called the coracoid process.

The lower, or pelvic, girdle consists of the *sacrum* and two bones of very irregular shape which are jointed to the sacrum behind, and join together in front to form a ring. On the outer side of this bone are deep hollows for the hip joint, and above this is a sort of wing on each side which together form a sort of basin—the pelvis—which supports the organs in the abdomen. This bone is called the innominate bone, and consists of three parts: the wing part, called the *ilium;* the part which comes forward and meets its fellow in front, called the *pubes;* and a part below them, which forms the lump of bone with which one sits, which is called the *ischium*.

The Limbs

The limbs, or extremities—the arms and legs—are each made up on the same plan. They consist of an upper division of one long bone—namely, the upper arm and the thigh; and a lower division of two long bones parallel to one another—namely, the forearm and the shank.

Below the lower division of each limb is a mass of small bones—wrist or ankle—and below this a grid of five bones—hand or foot—each bone of which is jointed on to a " digit," each consisting of two or three bones, end to end—the fingers and toes.

The upper arm bone is called the *humerus*.

The forearm bones are the *radius* and *ulna*.

The bones of the wrist are called the *carpus*, those of the hand the *metacarpus*, and those of the fingers the *phalanges*.

The thigh bone is called the femur. It has a long shaft; from its upper end projects a rounded head, pointing inwards and upwards, and forming part of the hip joint.

The bones of the shank are the *tibia* on the inner side, which has a prism-shaped, triangular shaft and large ends, and the *fibula*, which is on the outside and is a long thin stick of bone, with slightly enlarged ends.

The ankle is called the *tarsus*, the bones of the foot the *metatarsus*, and those of the toes the *phalanges*.

The bones are attached to one another by joints. Joints are of two kinds. There are those which are intended to prevent movement between bones, in which the two are closely mortised into one another. This occurs in the skull, which is made up of different plates of bones, as a boiler is made up of different plates of metal. These joints need not detain us further.

Joints and Movements

The others consist of the ends of two bones, covered with cartilage, which is smooth and allows easy movement. These bones are kept in place by ligaments which are strong sheets of white fibrous tissue, loose enough to allow movement but not enough to allow wide separation. The bones are also partly kept in place by the tendons, the fibrous ends of the muscles which move the joints. Inside all joints is a smooth membrane—the synovial membrane—whose surface is moistened by a greasy liquid which ensures easy movement.

The lower jaw is attached to the skull by a joint which acts as a hinge, and also allows the jaw to be moved, both from side to side and backwards and forwards, in chewing and talking.

The joints of the spine allow slight movement of each vertebra on its fellow, so that the spine can be bent forward and back, and from side to side, and twisted: although each joint moves very little the whole spine can bend a good deal.

The ribs are jointed on to the spine, and can move up and down for a short distance.

There is a great likeness between the joints of the arm and leg. The shoulder joint, which joins the arm to the shoulder-blade, and the hip joint, which joins the thigh to the " pelvic girdle," are both ball-and-socket joints, and the upper arm and thigh can be moved both forward and back, and also outwards and inwards.

Note here that the arm can be moved outwards till it is at right angles with the body: this is all done at the shoulder joint. If the arm is then moved till it is straight up in the air, the movement depends on the joints between the shoulder-blade and the collar-bone and the collar-bone and the breast-bone

The elbow and knee joints are both hinge joints, and can be bent double or stretched straight. There are, however, other joints in the forearm. Rest your forearm on the table with your palm downwards; now turn your hand over, and your palm upwards. This movement does not depend on the elbow joint, but on one joint between the humerus in the upper arm and the radius, the outer of the two bones of the forearm, and on another joint between the lower ends of these forearm bones. There is no corresponding movement of the leg bones.

The wrist and ankle are each made up of a number of bones, and the joints between them allow of movement of the hand and foot in all directions, which are much freer in the case of the hand. The chief movements in each case are forward and back.

The joints of the hands allow the fingers to be straightened and clenched, and separated and closed, and also the thumb and little finger can be placed tip to tip in *opposition*.

The joints of the toes allow similar movements, but the toes can be turned much farther back.

The Muscles in Play

All movements are made by muscles, which have the power of contraction. They are attached at one end to one bone, and at the opposite end to another, and there is a joint between the attachments. There are rough places on the bones where muscles are attached; the attachment is generally by means of white fibrous tissue which sometimes makes a cord called a "tendon."

The head is drawn forwards by muscles which run from the front of the spine to the base of the skull: backwards by muscles running from the back of the vertebræ of the neck to the lower part of the back of the skull. It is moved from side to side by muscles going up to it from the side of the neck, and it is moved round by others which run from behind the ear to the junction of the breast-bone and collar-bone.

The spine is moved backwards by a mass of muscle running along the back of the vertebræ. The chief of these is a large muscle called the "erector spinæ" (the lifter of the spine), which starts on the backs of the sacrum and the lumbar vertebræ, and ends in a number of strips which are attached to the upper vertebræ and the backs of the ribs. It is moved forwards chiefly by large muscles running from the lower border of the ribs to the front of the pelvis, and from side to side by others running from the ribs to the side of the pelvis. These muscles enclose the cavity of the abdomen in which lie the intestines and other organs.

We have seen that when the arm is lifted from the side till it is at right angles with the body, the shoulder-joint is moved, but when it is lifted from this position till it is straight above the head (that is, from the horizontal to the perpendicular) the joints between the collar-bone and shoulder-blade and shoulder-blade and breast-bone are moved. The chief muscle in this is the trapezius, a great sheet which starts from the back of the skull and the arches of the vertebræ of the neck and back.

The shoulder is a ball-and-socket joint.

The arm can be moved in three planes. It can move outwards, to and from your side; it can move forward and back when horizontal (away from your side), and also forward and back when close to your side like a pendulum. Besides this, it can be rolled round in its socket for some distance.

All these movements are made by muscles, only a few of the largest of which are here mentioned.

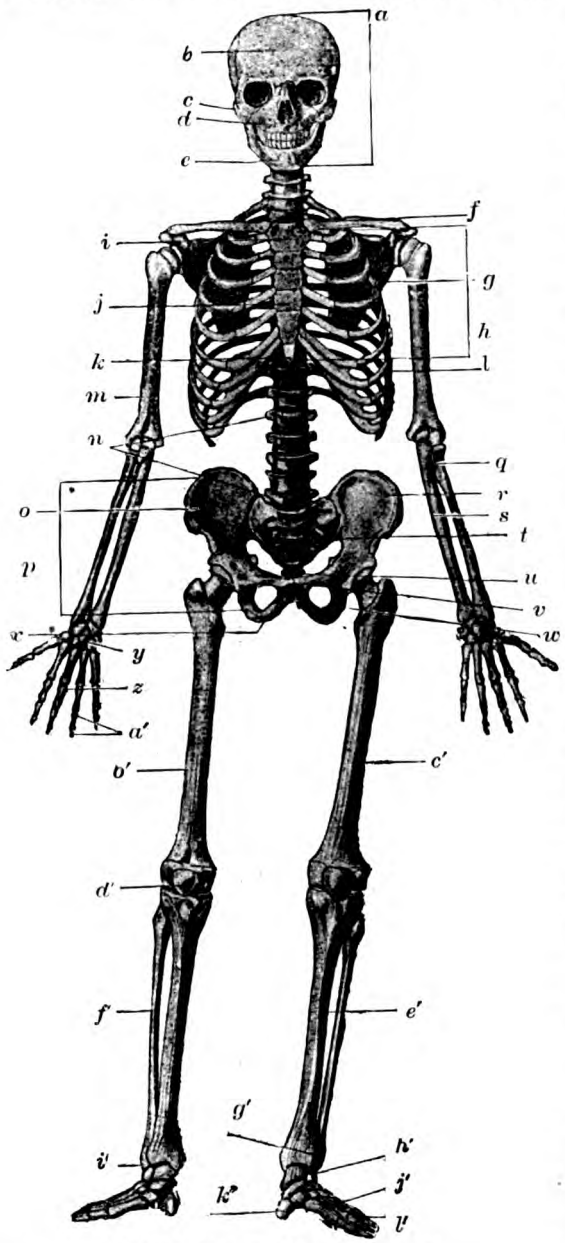
Muscles are described as rising, or having an origin, from one bone near the centre of the body, and being attached to or having insertion into another bone farther from the centre.

Muscle Functions

Abduction is performed by the *deltoid*, which is a triangular muscle rising from the lower edge of the spine of the scapula and the lower edge of the outer half of the clavicle. The fibres run to a point and are inserted into the shaft of the humerus on its outer side.

Adduction is done by two muscles, one in front and one behind. The *pectoralis major* in front is also triangular; it rises from the inner half of the lower edge of the clavicle and from the front of the breast-bone. Its fibres run to a point and are inserted into the inner side of the shaft of the humerus. The *latissimus dorsi* behind rises from the lower six dorsal vertebræ, the lumbar vertebræ, the sacrum and the edge of the ilium; its fibres run together and are inserted also into the shaft of the humerus.

Protraction is done by the pectoralis and the front part of the deltoid, and also by a muscle called the *serratus magnus*, which



BONES OF THE HUMAN BODY.

***a**, Skull; **b**, Frontal Bone; **c**, Malar Bone; **d**, Superior Maxillary Bone; **e**, Inferior Maxillary Bone; **f**, Clavicle; **g**, Scapula; **h**, Sternum; **i**, Manubrium; **j**, Gladiolus; **k**, Ensiform Cartilage; **l**, Ribs; **m**, Humerus; **n**, Lumbar Vertebræ; **o**, Ilium; **p**, Pelvis; **q**, Radius; **r**, Os Innominatum; **s**, Ulna; **t**, Sacrum; **u**, Coccyx; **v**, Pubis; **w**, Ischium; **x**, Symphysis; **y**, Carpal Bones; **z**, Metacarpal Bones; **a'**, Phalanges; **b'**, Femur; **c'**, Shaft; **d'**, Patella; **e'**, Tibia; **f'**, Fibula; **g'**, External Malleolus; **h'**, Tarsal Bones; **i'**, Internal Malleolus; **j'**, Metatarsal Bones; **k'**, Os Calcis; **l'**, Phalanges.*

rises from the front of the ribs and runs backwards under the shoulder-blade, and is attached to the border nearest the spine.

Retraction is done by the latissimus dorsi on the back part of the deltoid.

The elbow joint can only be straightened (or *extended*) and bent (or *flexed*). It is bent by two muscles; the *biceps*, and the *brachialis anticus*. The biceps is a long muscle which rises by two tendons or *heads* as they are called (biceps means double-headed); one of these rises from the scapula just above the shoulder joint, and the other from the hooked piece of bone also belonging to the scapula called the coracoid process. The muscle runs down the front of the upper arm and is inserted into the outer bone of the forearm—the radius—near its upper end. The brachialis anticus rises from the front of the upper arm and is inserted into the front of the inner bone of the forearm—the ulna—near its upper end.

The elbow is extended by the *triceps*, which rises by three heads. One of these is from the scapula just below the shoulder joint, and the other two from the back of the humerus. The muscle runs down the back of the upper arm and is inserted into the top of the ulna.

The chief movements of the wrist and fingers are flexion and extension.

Most of the muscles concerned in the movement of flexion rise from the inner side of the lower end of the humerus and from the front of the ulna, also in part from the radius. The muscles run down the forearm and soon end in long tendons, which are inserted into the bones on each side of the wrist in front, and into the fronts of the tips of the fingers. Along the fingers the tendons run in tunnels of tough connective tissue, which keep them close up to the bones they have to move.

For extending, there are corresponding muscles on the back of the forearm, whose tendons are attached to the back of the wrist and fingers, and extend their joints.

Pronation—that is, turning the hand palm downwards—is done by muscles which rise from the front of the ulna and cross the forearm and are inserted into the front of the radius; when they contract, they pull the radius across.

Supination, or turning the palm upwards, is done by the biceps, which is so inserted into the radius that it pulls the radius into the palm-upwards position before it bends the elbow. It is assisted by other muscles.

The small movements of the hands—

separating and closing the fingers (not clenching the fist)—are made by small muscles running from the palm and back of the hand to the fingers.

As for the chief muscles of the leg, the hip, a ball-and-socket joint, can be moved in three planes.

It is drawn forward by the *ilio-psoas*, which rises from the sides of the lumbar vertebræ and the inside of the ilium, and is inserted into a projection on the femur on its inner side near the top.

It is drawn back by the *gluteus maximus*, which rises from the outside of the ilium and the back of the sacrum, and is inserted into the femur in its upper and outer part. It is drawn out by the *gluteus medius* and *minimus*, which rise from the outside of the ilium in front of the gluteus maximus, and are inserted into the top of the femur. The gluteus muscles form the rump.

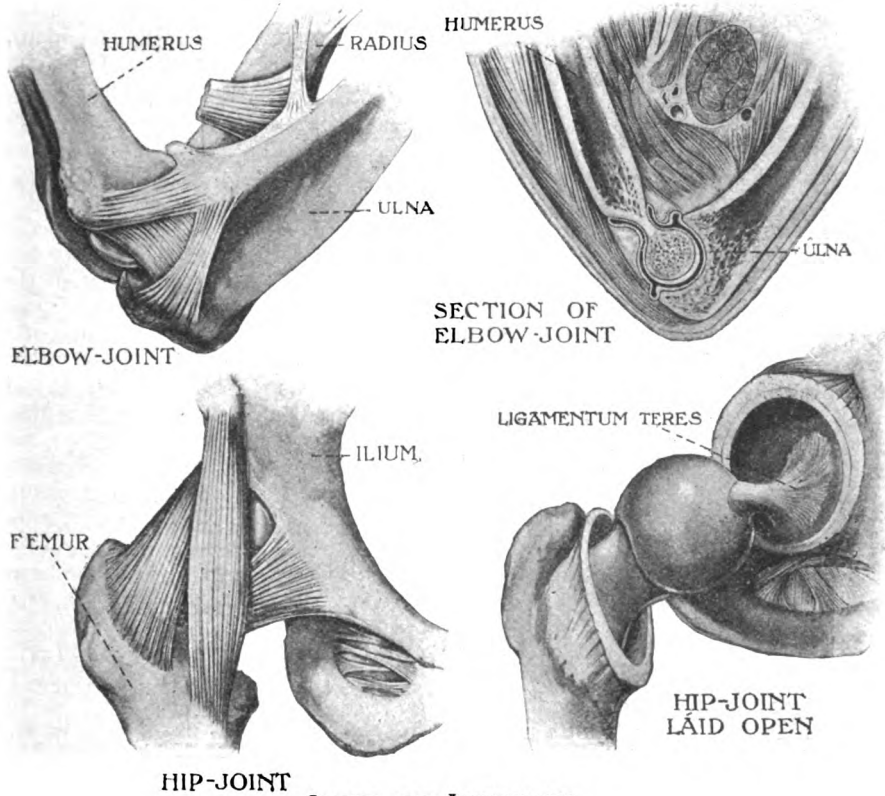
It is drawn in by the adductors, which rise from the pubes and run down and out and are attached to the lower part of the inside of the femur.

The knee is extended by the *quadriceps*. It ends in a tendon inside which is the knee-cap, and is inserted into the front of the upper part of the tibia. The knee is flexed by the hamstring muscles of the thigh.

The chief movements of the ankle and toes are flexion and extension. When the foot is pushed out straight, it is called extension; but when this movement is completed by screwing up the toes, it is called flexing them. Also, when the ankle is turned up, it is called flexion, and when the toes are turned up, it is called extension. The confusion only arises from the words used. So flexion of ankle and extension of toes go together. The muscles concerned arise from the outer side of the tibia and the front of the fibula, and are inserted into the inner side of the ankle and into the toes, like the corresponding tendons of the hand.

Muscles extending the ankle are the *gastrocnemius* and *soleus*. These rise from the backs of the tibia and fibula, and are inserted into the heel-bone, a part of the ankle which projects backwards. The flexors of the toes also rise from the backs of the tibia and fibula, and are attached in a manner corresponding to the tendons in the hands.

D. W. C.-J.



JOINTS AND LIGAMENTS.

Continued from page 99.

LANGUAGES:

Contributors:—LATIN, GREEK and FRENCH (E. A. Baker, M.A., D.Lit.). GERMAN (M. A. Lewenz, M.A.[Lond.]). SPANISH, RUSSIAN and ITALIAN (Alfred Calvert, First Prizeman in Modern Languages, R.S.A., London).

LATIN.—XXVII

THE main uses of the ablative may be classified under three heads :—

(1) The ablative proper, originally denoting the place whence a thing comes. The ablatives of origin, of separation, of comparison, and of the agent, are variants of this in meaning. Thus when we compare two things, we may regard ourselves as forming an estimate of one from the other as a standard.

(2) The instrumental ablative, with which must be grouped the ablative of manner, cause, price, etc., as well as the ablative absolute.

(3) The local ablative, denoting the place where any event happens. Subdivisions of this are the ablative of respect and of time.

The Ablative Proper

(*a*) The ablative denoting the place whence motion takes place is used without a preposition only in the case of towns, small islands, or the words **dŏmō**, *from home*, **hŭmō**, *from the ground*, and **rūre**, *from the country*. Examples :—

Brundisio profectus est.
He has set out from Brundisium.
Rure in urbem migravit.
He has removed from the country to the city.

With other words a preposition is used as in :—

Ex ea parte vici discessit hostis.
The enemy departed from that part of the village.
De altera parte agri Sequanos decedere iussit.
He ordered the Sequani to withdraw from the other part of the territory.
Maturat **ab urbe** proficisci.
He hastens to depart from the city.
Omnia fucata atque simulata **a sinceris** atque **veris** internoscere.
To distinguish all things that are coloured and simulated from the sincere and the true.

(*b*) This ablative is used to express origin or source, as in :—

Maecenas, **atavis** edite regibus.
Maecenas, descended from royal ancestors.
Ego **equestri** ortus **loco** consul sum.
I who am descended from equestrian rank am consul.
Nate **dea**! *O son of a goddess!*
Musa matre nati. *Born of the Muse as their mother.*

The close affinity of this use of the ablative to the preceding is illustrated by such examples as the following, in which the idea of origin is scarcely differentiated from that of departure from a place, and a preposition is used :—

Ex nobis natos liberos appellamus.
Those born of us we call our children.
Quum videritis nubem orientem **ab occasu**.
When you see a cloud rising out of the west.

(*c*) Verbs expressing separation, depriving, refraining, etc., especially when compounded with one of the prepositions **ăb**, **dē**, **ex**, and **sē**, take the ablative without a preposition. Examples :—

Nec posse **Italia** Teucrorum avertere regem ?
Cannot I turn aside the King of the Trojans from Italy?
Aqua atque **igni** arcebatur.
He was kept away from water and fire.

A preposition is sometimes prefixed to this ablative, as in :—

Tu, Iuppiter, hunc **a tuis aris** arcebis.
Thou, O Jupiter, will keep this man away from thy altars.

(*d*) Why the ablative of comparison is affiliated to the ablative of separation or divergence has been explained ; the following illustrate this point :—

Vilius argentum est **auro**, virtutibus aurum.
Silver is of less value than gold, gold of less value than virtues.
Herodotum cur veraciorem ducam **Ennio** ?
Why should I consider Herodotus more truthful than Ennius?

(*e*) The ablative of the agent may be classed with that of the place whence,

since the person by whom a thing is done may be regarded as the source of action. This ablative is preceded by the preposition **ăb** or **ā**, *by* (lit. *from*), as in :—

Laudatur **ab his**, culpatur ab illis.
He is praised by these, blamed by those.

The Instrumental Ablative

In considering the various uses classified under this head, we must bear in mind that Latin once had an instrumental case, which expressed the instrument, means, or accompanying circumstances of an action, and is usually rendered in English by the preposition *with*. The functions of this case have been taken over by the ablative.

(*a*) The ablative of the instrument denotes the means by which an action is performed. It is used with both active or passive verbs. Examples :—

Stricto ferit retinacula **ferro**.
He cuts the nets to pieces with his drawn sword.
Etesiarum **flatu** nimii temperantur calores.
The excessive heat is tempered by the trade-winds.

Note that the instrument or means is sometimes expressed by **pĕr** with the accusative, as in :—

Quae domi gerenda sunt ea **per Caeciliam** transiguntur.
The things that must be done at home are performed by Caecilia.

The poets sometimes use the preposition **ăb** with the ablative of the instrument ; or to put it another way, in the figurative language of poetry inanimate objects or abstractions are regarded as agents of the action, thus :—

Mollimur **ab arte**. *We are softened by art.*

(*b*) The road by which a journey is made is often put in the ablative, a use that comes under this head. Examples :—

Ibam forte **Via Sacra**.
I happened to be going by the Sacred Way.
Eadem via pergere.
To push on by the same road.

(*c*) Another extension of the instrumental ablative is the ablative of cause :—

Pallescebat **curis**.
She grew pale through her cares.
Ignorantia loci aberravit.
He went astray through ignorance of the district.

(*d*) The price at which anything is bought, sold, or valued is put in the ablative case, thus :—

Duodeviginti **minis** emit.
He bought it for eighteen minae.
Unae quadrigae Romae constiterunt **quadringentis** millibus.
One four-horse team cost at Rome four million sesterces.

(*e*) The measure of difference between two things is expressed by the ablative case, thus :—

Ille quam Messalla **uno vitio** minus vitiosus erat.
He was less vicious than Messalla by one vice.
Numa Pompilius **annis permultis** ante fuit quam Pythagoras.
Numa Pompilius preceded Pythagoras by many years.

(*f*) The manner in which an action is performed or any attendant circumstances are expressed by the ablative, as in :—

Repulsam consulatus **aequo animo** tulit.
He bore his defeat for the consulate with equanimity (lit., *with an equal mind*).
Iniuria fit **duobis modis**, aut **vi** aut **fraude**.
Wrong is inflicted by two methods, either by force or fraud.

The substantive in the ablative is usually accompanied by an adjective, as in the first of these examples. The exceptions are words like **artĕ**, **cāsū**, **dŏlō**, **fraudĕ**, **iniūriā**, **mŏdō**, **mōrē**, **rătiōnĕ**, **silentiō**, **vī**. With other words the preposition **cum** is used, as in :—

Pars **cum cruciatu** necabatur.
Part was put to death by torture.
Tullia **cum lacrimis** eum obsecravit.
Tullia implored him with tears.

(*g*) The ablative of quality is used with an attributive adjective to describe qualities usually of an external and accidental nature. It differs thus from the genitive of quality, considered in the last lesson, which expresses inherent or characteristic qualities. Examples :—

Zeno fuit vir **summo ingenio**.
Zeno was a man of the greatest ability.
Magno timore sum.
I am characterised by great timidity.

(*h*) An ablative with an adjective, a participle, or another substantive standing in a predicative relation to it, may be used to express the manner or circumstances of the action. Since it stands independent of the construction of the sentence, this is commonly called the "ablative absolute," but is better described as the "ablative of attendant circumstances." Examples :—

Oriente sole milites in pugnam redeunt.
At sunrise (the sun rising) the soldiers return to the fight.
Cupio tibi, quod **salva fide** possum, parcere.
I desire to spare you whatever I can without breaking faith (with faith inviolate).

The Local Ablative

(*a*) The ablative is used without a preposition to denote the place where an action occurs only in names of towns or small islands which have a plural form or belong

to a third declension, in the phrase **terrā mārīquĕ**, *by land and sea*, and a few others, and in substantives qualified by an adjective. Examples :—

Insidiae **terrā marique** factae sunt.
Snares were laid by land and sea.
Bellum **terrā** et **mari** comparat.
He makes war by land and sea.
Fuit Arganthonius quidam **Gadibus** qui octaginta regnavit annos.
There was a certain Arganthonius at Gades, who ruled eighty years.

(*b*) The ablative of respect is an extension of this ; it is used to denote the part or thing concerned in the idea expressed in a verb or adjective. Examples :—

In eo non tu quidem **tota re** sed **temporibus** errasti.
In this you have not indeed gone totally astray but with regard to dates.
Medea **animo** aegra erat.
Medea was sick in mind.

(*c*) The ablative expressing the time at which an action is performed is also a variation of the local ablative. Examples :—

Nemo mortalium **omnibus horis** sapit.
None of mortals is wise at all hours.
Consules **Kalendis Ianuariis** instituti sunt.
The consuls are appointed at the Calends of January.
Prima luce postridie constituunt proficisci.
They determine to set out next day at early dawn.

Note that in the last example there are two instances of the temporal ablative. In **prīmā lūcĕ** the substantive is accompanied by an adjective, as is usually the case ; **postrīdiē** is one of the words like **aestātĕ**, *in summer*, **hŏdiē**, *to-day*, and **vērĕ**, *in spring*, that are used without an adjective.

(*d*) The time within which anything takes place is also expressed by the ablative as in :—

Urbes Africae **annis** prope quinquaginta exercitum Romanum non viderant.
The cities of Africa had not seen a Roman army for nearly fifty years.

Exercise 26

Translate into English :—

1. Aqua ferventi Philodamus perfunditur. 2. Ossaque et artus perfudit toto proruptus corpore sudor. 3. Munere quodam necessitatis et gravi opere perfungimur. 4. Pergam, quo coepi, hoc iter. 5. Vitellius fortunam principatus inerti luxu ac prodigis epueis praesumebat. 6. Haec ad te in praesenti scripsi, ut speres.

Translate into Latin :—

1. He departed from me at the Ides. 2. The Rhine rises in the Lepontine (Alps). 3. A discourse proceeds from a certain man. 4. Caesar will be born a Trojan of illustrious origin. 5. Perspiration is stimulated (moved) by exercise. 6. He warned them not to move from this spot. E. A. B.

FRENCH.—XXVII

The definite article, as already illustrated, is used before nouns employed in a general sense, as in—

Les jardins sont les ornements des villages et des campagnes,	*Gardens are the ornaments of villages and of rural districts.*

It is also used before abstract nouns, and also before verbs, adjectives, or any other part of speech used substantively. This is contrary to English usage. Examples :—

La paresse est odieuse,	*Idleness is odious.*
La jeunesse n'est pas toujours docile,	*Youth is not always tractable.*
Le boire et le manger sont nécessaires à la vie,	*Drinking and eating are necessary to life.*
Les mais, les si, les car arrêtent tout,	*Buts, ifs, fors stand in the way of everything.*

The article is put before the names of countries, provinces, rivers, mountains, winds, etc., in fact, before any geographical term except the names of towns and small islands, thus—

La France est plus grande que l'Italie,	*France is larger than Italy.*
La Normandie est très fertile,	*Normandy is very fertile.*

Note that the article is omitted when the place-name is preceded by the preposition **en**, thus—

En France, en Amérique, *In France, in America.*

It is used before titles followed by names, as in—

Le général Cavaignac,	*General Cavaignac.*
La reine Marguérite,	*Queen Margaret.*

Note that in respectful address or discourse the titles **Monsieur, Madame, Mademoiselle** are put before titles, designations of relationship, etc., thus—

Monsieur le président,	(*Mr.*) *President.*
Mademoiselle votre sœur,	*Your sister.*
Messieurs les assassins,	(*Their worships*) *the assassins.*

Care should be taken to distinguish between nouns taken in a general or in a particular sense and nouns taken in a partitive sense. Examples :—

General or particular sense	*Partitive sense*
Nous aimons les livres, *we like books.*	Nous avons des livres, *we have* (some) *books.*
Nous avons les livres, *we have the books.*	Vous avez écrit des lettres, *you have written* (some) *letters.*

The definite article is put before adjectives denoting nationality, as in—

Il apprend le français, l'anglais, l'allemand, l'italien.	*He learns French, English, German, Italian.*

After the verb **parler**, *to speak*, however, the article is omitted, thus—

Votre frère parle espagnol et portugaise,	*Your brother speaks Spanish and Portuguese.*

It is used before nouns denoting measure, quantity, weight, etc., as in—

Quatre francs la livre,	*Four francs a pound.*

It is used before nouns denoting parts of the body, as in—

Se laver les mains,	*To wash one's hands.*

It is not used before a noun used predicatively with **être** or other copulative verb, unless such noun is qualified by an adjective or otherwise determined attributively, as in—

Votre ami est médecin,	*Your friend is a physician.*
Notre frère est avocat,	*Our brother is an advocate.*
Je suis français, vous êtes Américain,	*I am a Frenchman, you are an American.*
Votre ami est un bon médecin,	*Your friend is a good physician.*
Notre frère est un avocat célèbre,	*Our brother is a celebrated barrister.*
Ces messieurs sont des marchands de Lyon,	*Those gentlemen are merchants from Lyons.*

It is often omitted before nouns in a rapid enumeration, thus—

Citoyens, étrangers, amis, ennemis, tous le révèrent,	*Citizens, strangers, friends, enemies—all reverence him.*

It is not used between two substantives in apposition, as in—

Louis Quatorze, roi de France,	*Louis XIV., king of France.*
Louis Treize, fils de Henri quatre,	*Louis XIII., the son of Henry IV.*
Lui, père de famille,	*He, the father of a family.*
Lamartine, célèbre poëte et prosateur français,	*Lamartine, the famous French poet and prose-writer.*

It is not used before the number following the name of a sovereign, thus—

Vous avez l'histoire de Henri Quatre,	*You have the history of Henry IV.*
Louis dix-huit, Charles dix,	*Louis XVIII., Charles X.*

Nouns denoting vessels, utensils, etc., pertaining to particular commodities, are connected with the noun denoting the commodity by the preposition **à**. When the nouns are connected by the preposition **de**, the meaning is that the vessel contains the commodity. Examples :—

Un verre à vin,	*A wineglass.*
Un verre de vin,	*A glass of wine.*
Un pot à lait,	*A milk-jug.*
Une bouteille à encre,	*An ink-bottle.*
Une bouteille d'encre,	*A bottle of ink.*

IDIOMS IN WHICH THE ARTICLE IS OMITTED

Ajouter foi, *to give credit.*	Faire horreur, *to inspire horror.*
Avec ardeur, etc., *with ardour.*	Faire mention, *to mention.*
Avoir appétit, *to have an appetite.*	Faire naufrage, *to suffer shipwreck.*
Avoir besoin, *to have need.*	Faire peur, *to frighten.*
Avoir chaud, *to be warm.*	Faire place, *to make room.*
Avoir coutume, *to be accustomed.*	Faire plaisir, *to oblige.*
Avoir dessein, *to intend.*	Faire présent, *to present.*
Avoir dispute, *to have difficulties.*	Faire réflexion, *to reflect.*
Avoir envie, *to wish, to desire.*	Faire tort, *to injure.*
Avoir faim, *to be hungry.*	Mettre fin, *to put an end.*
Avoir froid, *to be cold.*	Mettre ordre, *to arrange.*
Avoir honte, *to be ashamed.*	Par dépit, etc., *through spite.*
Avoir mal, *to have a pain.*	Perdre courage, *to lose courage.*
Avoir patience, *to have patience.*	Porter envie, *to envy.*
Avoir peur, *to be afraid.*	Porter malheur, *to bring ill-luck.*
Avoir pitié, *to take pity.*	Pour récompense, etc., *as a reward.*
Avoir raison, *to be right.*	Prendre congé, *to take leave.*
Avoir soif, *to be thirsty.*	Prendre feu, *to catch fire.*
Avoir soin, *to take care.*	Prendre garde, *to take care.*
Avoir sommeil, *to be sleepy.*	Prendre haleine, *to take breath.*
Avoir sujet, *to have reason.*	Prendre médecine, *to take medicine.*
Avoir tort, *to be wrong.*	Prendre racine, *to take root.*
Chercher fortune, *to seek one's fortune.*	Rendre compte, *to account.*
Courir risque, *to run the risk.*	Rendre justice, *to render justice.*
Demander justice, *to demand justice.*	Rendre service, *to oblige.*
Demander pardon, *to beg pardon.*	Rendre visite, *to visit.*
Donner avis, / Faire part, *to inform.*	Sans peine, *without difficulty.*
Entendre raillerie, *to bear jokes.*	Sans souci, *without sorrow* or *care.*
Faire attention, *to pay attention.*	Tenir compagnie, *to keep company.*
Faire bonne chère, *to live well.*	Tenir lieu, *to take the place.*
Faire crédit, *to sell on credit.*	Tenir parole, *to keep one's word.*
Faire envie, *to excite envy.*	Trouver moyen, *to find means.*
Faire honneur, *to honour.*	

VOCABULARY

affliger, *to grieve.*	le gouverneur, *the governor.*
ancien, *ancient.*	illustre, *illustrious.*
l'applaudissement, m., *applause.*	la joue, *the cheek.*
la bienveillance, *good-will.*	louable, *praiseworthy.*
chausser, *to cause to be shod.*	la marque, *the mark.*
la comédie, *comedy.*	les mœurs, *manners.*
le conseil, *advice.*	le palatin, *the palatine.*
le côte, *the side.*	parmi, *among.*
couvert, *covered.*	le pays, *the country.*
la culture, *cultivation.*	de petites maisons, *lunatic asylums.*
le duc, *the duke.*	la régularité, *regularity.*
le duvet, *down.*	repaître, *to feed* (upon).
	le roman, *the novel.*
	la sandale, *the sandal.*

l'estime, *f.*, *esteem.*
l'exemple, m., *the example.*
fouler, *to tread.*
gagner, *to gain, to improve.*
le gout, *taste.*
la solidité, *solidity.*
suffire, *to be enough.*
suivre, *to follow.*
le système, *the system.*
le vaisseau, *the vessel.*

Exercise 51

1. Du pain et de l'eau lui suffisent. 2. Apportez-nous du sel et du vinaigre. 3. Proposons-nous à nous-mêmes de grands exemples à imiter, plutôt que de vains systèmes à suivre. 4. Heureux si de son temps, pour de bonnes raisons, la Macédoine eût eu de petites maisons. 5. Une multitude de peuples! 6. A quoi bon tant d'amis? Un seul nous suffit s'il nous aime. 7. Un grand nombre des personnes que j'ai vues. 8. Ne donnez jamais des conseils qu'il soit dangereux de suivre. 9. On ne fait jamais de bien à Dieu, en faisant du mal aux hommes. 10. Le père et la mère semblaient exciter leur petite compagne à s'en repaître la première. 11. J'ai vu bien d'autres pays. 12. Le sage et pieux Fénelon a des droits bien acquis à l'estime générale. 13. Les joues ou côtés de la tête sont couvertes d'un duvet noir. 14. Plus une action est utile, plus elle est louable. 15. Votre sœur ne pleurait pas, quoi-qu'elle fût la plus affligée de toutes ces dames. 16. Votre sœur ne pleure pas, lors même qu'elle est le plus affligée. 17. Je ne connais point de roman, point de comédie espagnole sans combats. 18. Le bon goût des Egyptiens leur fit aimer la solidité et la régularité toutes nues. 19. Le sourire est une marque de bienveillance, d'applaudissement, et de satisfaction intérieure.

Exercise 52

1. The duke owes to the late queen's good-will towards him the good graces of the emperor. 2. He was bare-headed; he wore small sandals on his feet. 3. Half an hour after leaving the ship, I trod American soil. 4. Accustom your children to remain, summer and winter, day and night, always bare-headed. 5. Opimius paid for the head of Caius Gracchus seventeen pounds and a half of gold. 6. Many persons. 7. I have few left of the books that have been given me. 8. The wicked have great trouble to remain united. 9. I shall not cast any reproaches upon you. 10. We never say that we have no wit. 11. The heart, the mind, the manners, everything improves by cultivation. 12. Ancient and modern history. 13. Ancient and modern philosophers. 14. At these words he presents to her the sweet and tender book. 15. They distinguished among the nobles the palatines or governors of provinces.

Key to Exercise 45

1. Were you not afraid of offending that lady? 2. I was afraid of offending her, but I could not do otherwise. 3. What were you painting this morning? 4. I was painting an historical picture. 5. Were you taking that young man to school when I met you? 6. I was taking my eldest son to church. 7. What were you reading? 8. I was reading some books that I had just bought. 9. What has been taken from you? 10. My books, my pencils, and my penknife have been taken from me. 11. I do not know the person who took them, but I know that he lives here. 12. Tell me where M. Harcourt lives. 13. He has been writing these two hours. 14. How many months did you learn German? 15. He has lived at Paris one month. 16. How far is it from Paris to London? 17. Have you been here long? 18. Have the company been here long? 19. Ah! it is not always an advantage to be a bad lot. 20. Like worms getting at a man's body before he had expired.

E. A. B.

GERMAN—XXIV.

Conjunctive Mood.—This is used far more in German than the Subjunctive Mood in English. Our own Subjunctive and all expressions with *may, might, would, could,* can be rendered in German by the various tenses of the Conjunctive, but many of the uses of this mood in German have no English equivalent and must be translated by the Indicative.

The Conjunctive is the mood of hope, doubt, possibility, purpose, permission, indirect assertion, etc., in contradistinction to the Indicative, which is the mood of fact and direct assertion. We may say that the Conjunctive expresses the subjective, whereas the Indicative expresses the objective point of view.

There is a good deal of latitude in the use of the moods in German, and in a great many of the cases which will be treated below, the Indicative may be used instead of the Conjunctive.

The distinction between the tenses of the Conjunctive has largely disappeared, we shall therefore not treat them separately as we did those of the Indicative, but shall instead examine the cases in which the Conjunctive is used.

Optative Use.—The Present tense is often used to express a wish or request. Thus, lang lebe der König, *long live the king!* Only the 3rd person sing. and plur. and the 1st person plur. can be used in this sense. The subject follows the verb, except in the 3rd person sing., when it may either precede or follow the verb. Thus, jeder tue was er wolle, or tue jeder was er wolle, *let each one do as he likes.*

In all other persons the modal auxiliary mögen must be used, and can be used in the 3rd person sing. and plur. and the 1st person plur. as well. Thus, mögen wir glücklich sein, *may we be happy;* möget ihr bald erfolgreich sein, *may you soon be successful.*

This use of the Conjunctive supplements the Imperative mood. Thus, seien Sie nicht böse, *do not be angry;* es freue sich wer da atmet im rosigsten Licht, *let him rejoice who breathes in the rosy light.*

This use also sometimes expresses concession or supposition. Thus, er sei wirklich König, er muß doch sterben, *though he really be a king, yet he must die.* Hence with the addition of denn it must often be rendered by *unless.* Thus, es sei denn daß er heute ankommt, *unless he come to-day.*

The simple Past and Pluperfect tenses are also sometimes used in an optative

sense, but mostly in elliptical sentences where the principal clause is understood. Thus, wäre ich doch zu Hauſe, *if only I were at home* (then matters would be better).

Conditional and Potential Use. — A complete statement containing a hypothesis and a conclusion which follows if the hypothesis or condition is true, is expressed in German by using a past tense of the Conjunctive in both clauses.

When the condition is expressed without the conjunction wenn, the verb precedes the subject. Thus, wäre er rechtzeitig hier geweſen, hätte er es verhindern können, *had he been here in time he might have prevented it;* regnete es nicht ſo ſtark, würde ich ausgehen, *if it did not rain so hard I would go out.* This last example shows that the compound (alternative) form of the Past Conjunctive can be used in the principal clause.

The principal clause may be placed first. Thus, ſie hätte es ſofort eingeſtanden, wäre er nicht ſo ſtreng geweſen, *she would have confessed it at once had he not been so stern.*

Any of the above can be rendered by means of the conjunction wenn instead of the inverted order. Thus, wenn er rechtzeitig hier geweſen wäre, hätte er es verhindern können.

The principal clause may take the form of a question. Thus, was hätte ſie getan wenn Sie nicht gekommen wären? *what would she have done if you had not come?*

In such sentences if the Present or Perfect tenses are required the Indicative is always used; in these cases the hypothesis is not contrary to reality, as in the above examples, but is merely regarded as uncertain. Thus, wenn er heute kommt, werde ich mit ihm ſprechen, *if he comes to-day I will speak to him;* wenn er ſchon fortgereiſt iſt muß ich ihm nachreiſen, *if he has already gone away I must go* (travel) *after him.*

The Indicative can even be used in the Preterite tense, so long as the hypothesis is not looked upon as contrary to reality. Thus, wenn ſie ſchon dort war wird ſie nicht wieder hingehen wollen, *if she has already been there she will not want to go again.*

Very often either the hypothesis or the conclusion is not expressed, but is more or less clearly implied. When the conclusion is completely omitted the word doch or nur is often introduced and corresponds exactly to our use of "if only." Thus, wenn wir doch zu Hauſe wären or wären wir nur zu Hauſe, *if only we were at home;* the conclusion implied being "how much better it would be." This is practically the same as an optative.

The conclusion is sometimes implied by als, *as*, followed by ob, wenn, *if*, or the inverted order. Thus, er ſchrie als ob er gemordet würde, *he shrieked as* (he would shriek) *if he were being murdered;* ſie ſpricht als wenn ſie eine Fremde wäre, *she speaks as* (she would speak) *if she were a foreigner;* er benimmt ſich als ſei er verrückt, *he behaves as* (he would behave) *if he were mad.* In this latter case the Past wäre can be used instead of the Present ſei; in English, of course, only the Past tense can be used in the inverted order.

The conclusion may also be expressed in other ways. Thus, er hatte die Abſicht falls es nötig ſei denſelben Tag noch abzureiſen, *he intended if it were necessary to go away the very same day.* Here again wäre could be used instead of ſei.

Sometimes the conclusion is fully expressed and the hypothesis is implied by some word or words. Thus, in dem Fall täte er unrecht zu bleiben, *in that case* (if that were the case) *he would do wrong to stay;* ich wäre damit zufrieden, *I should be satisfied with that* (if certain conditions were fulfilled).

The compound form of the Past Conjunctive can also be used in this sense. Thus, er würde dann ſofort kommen, *he would come at once then* (if certain conditions were fulfilled).

The Past tenses of the Conjunctive are used in a potential sense to indicate what under given circumstances might or should be. Thus, es hätte keiner etwas dagegen gehabt, *no one would have objected to it;* das wäre wohl das beſte, *that would be the best.*

This use is sometimes put where we should expect the Indicative, in order to make an assertion less positive. Thus, ich möchte etwas Brot haben, *I should like to have some bread;* ſie wären faſt überfahren worden, *they were almost run over.*

The compound form of the Past Conjunctive can also be used in this potential sense. Thus, es würde unhöflich ſein nicht hinzugehen, *it would be impolite not to go there.*

VOCABULARY

gewölbt, *domed.*
gothiſch, *Gothic.*
Seſſel, s.m.1, *chair, armchair.*
Philoſophie, w.f., *philosophy.*
Medicin', w.f., *medicine.*
Theologie', w.f., *theology.*
ſtudieren, w., *to study.*
Bemühn, s.n., *exertion, pains.*
eng, *narrow.*
unruhig, *restless.*
Pult, s.m.2, *desk.*
Juriſterei, w.f., *lawyer's craft.*
leider, *to my regret, unfortunately.*
durchaus, *throughout, thoroughly.*
heiß, *hot, ardent.*
klug, *wise, clever.*

zuvor, *before.*
heißen, s., *to be called.*
Magiſter, s.m.1, *master.*
gar, *even.*
herauf, *up.*
quer, *across, athwart, diagonally.*
Schüler, s.m.1, *pupil.*
herum, *round about.*
verbrennen, w., *to burn up.*
geſcheit, *clever, intelligent.*
Schreiber, s.m.1, *scribe,* i.e. *secretary.*
plagen, w., *to plague.*
Zweifel, s.m.1, *doubt.*
Hölle, w.f., *hell.*
weder . . . noch, *neither . . . nor.*
entreißen, s., *to snatch away.*
recht, *right, proper.*
beſſern, w., *to improve.*
Gut, s.n.3, *goods, possessions.*
Herrlichkeit, *splendour.*
ſich ergeben, *to yield, devote oneself to.*
Geiſt, s.m.3, *spirit.*
Geheimniß, s.n.2, *secret.*
ſauer, *sour, bitter.*
brauchen, *to need.*
ſchauen, w., *to see.*
Samen, s.m.1, *seed.*
Pein, w.f., *pain, trouble.*
wachen, w., *to wake, watch.*
trübſelig, *melancholy.*
Höhle, w.f., *cave.*
Dämmer, s.n.1, *misty light.*
Wiſſen, s.n.1, *knowledge.*
entladen, s., *to unload.*
baden, w., *to bathe.*
Doctor, s.m. (weak plur.), *doctor.*
ziehen, s., *to drag, draw.*
herab, *down.*
krumm, *crooked.*
Naſe, w.f., *nose.*
ſchier, *wellnigh.*
zwar, *it is true, indeed.*
Laffe, w.m., *fop.*
Pfaffe, w.m., *priest.*
Scrupel, s.m.1, *scruple.*
ſich fürchten, w., *to be afraid of.*
Teufel, s.m.1, *devil.*
Freude, w.f., *pleasure.*
ſich einbilden, w., *to imagine.*
lehren, w., *to teach.*
bekehren, w., *to convert.*
Ehre, w.f., *honour.*
Hund, s.m.2, *dog.*
Magie', w.f., *magic.*
Kraft, w.s.f., *power.*
kund werden, *to become known.*
Schweiß, s.m., *sweat.*
erkennen, w., *to recognize, realize.*
zuſammenhalten, *to hold together.*
Wirkenskraft, s.f.2, *working power.*
kramen, w., *to rummage.*
Mitternacht, s.f.2, *midnight.*
Papier, s.n.2, *paper.*
Bergeshöhe, w.f., *mountain summit.*
Wieſe, w.f., *meadow.*
weben, s., *to move, soar.*
Qualm, s.m., *vapour, steam.*
Tau, s.m.2, *dew.*

The following exercise consists of a passage taken from the opening monologue of Goethe's tragedy *Faust.* To give an adequate translation of it is wellnigh impossible, so we shall content ourselves with giving a fairly literal rendering in the key, but it is hoped that with the help of the Vocabulary and the Notes the student will perhaps be able to appreciate some of its beauties.

Goethe is, of course, Germany's greatest man of letters. Born at Frankfort-on-the-Main in 1749, he lived to the age of 83. Poet, dramatist and essayist, his literary output was colossal.

Faust, one of the last of his many works, is the greatest of his productions. Goethe had applied himself at various times for sixty years to the work.

Exercise 55

In einem hochgewölbten, engen, gothiſchen Zimmer Fauſt unruhig auf ſeinem Seſſel am Pulte.

Fauſt.

Habe[1] nun, ach, Philoſophie,
Juriſterei und Medicin,
Und leider auch Theologie
Durchaus ſtudiert, mit heißem Bemühn[2].
Da ſteh' ich nun, ich armer Tor,
Und bin ſo klug, als wie[3] zuvor;
Heiße[4] Magiſter, heiße Doctor gar,
Und ziehe ſchon an die zehen Jahr
Herauf, herab, und quer und krumm
Meine Schüler an der Naſe[5] herum —
Und ſehe, daß wir nichts wiſſen können!
Das will[6] mir ſchier das Herz verbrennen.

Zwar bin ich geſcheiter als alle die Laffen,
Doctoren, Magiſter, Schreiber und Pfaffen;
Mich plagen keine Scrupel noch Zweifel.
Fürchte[7] mich weder vor Hölle noch Teufel —
Dafür[8] iſt mir auch alle Freud' entriſſen,
Bilde[9] mir nicht ein, was Rechts[10] zu wiſſen,
Bilde mir nicht ein, ich könnte[11] was lehren,
Die Menſchen zu beſſern und zu bekehren.

Auch hab' ich weder Gut noch Geld,
Noch Ehr' und Herrlichkeit der Welt[12];
Es möchte kein Hund ſo länger leben;
Drum[13] hab' ich mich der Magie ergeben,
Ob[14] mir durch Geiſtes Kraft und Mund[15]
Nicht manch Geheimniß würde kund,
Das ich nicht mehr, mit ſaurem Schweiß,
Zu ſagen brauche, was ich nicht weiß,
Daß[16] ich erkenn, was[17] die Welt
Im Innerſten zuſammenhält,
Schau'[18] alle Wirkenskraft und Samen[19],
Und tu'[20] nicht mehr in Worten kramen.

O, ſähſt[21] du, voller Mondenſchein,
Zum letzten Mal auf meine Pein,
Den[22] ich ſo manche Mitternacht
An dieſem Pult herangewacht[23]:
Dann über Büchern und Papier,
Trübſeliger Freund, erſchienſt du mir!
Ach, könnt'[24] ich doch auf Bergeshöhn[25]
In deinem lieben Lichte gehen[25],
Um Bergeshöhle[26] mit Geiſtern ſchweben,
Auf Wieſen in deinem Dämmer weben,
Von allem Wiſſensqualm entladen[27]
In deinem Tau geſund[28] mich baden!

NOTES:

(1) habe—the subject ich is omitted. (2) Bemühn—contracted form of the infinitive bemühen used as a noun; the student will find a number of similar contractions in the extract. On the other hand, in zehen (line 8) we have the old fuller form. (3) als wie, *as.* (4) heiße, *see* (1). (5) an der Naſe herumziehen, *to lead* (about) *by the nose,* i.e. to trick or deceive. (6) will—the verb wollen is quite often used in the sense of "to be ready to do a thing" or "to be on the point of doing a thing." (7) fürchte, *see* (1). (8) dafür, *for that,* i.e. in return. (9) Bilde, *see* (1). (10) was Rechts, i.e. etwas Rechtes, anything proper or real; hence, in this case, anything worth knowing. (11) ich könnte—when the introductory subordinative conjunction is omitted, as here, the following dependent clause has the word order of a principal clause. For the use of the Conjunctive könnte and, 4 lines below, möchte, *see* the beginning of this Lesson. (12) der Welt, here equivalent to the adjective "worldly."

(13) drum, contracted from darum, *therefore*. (14) ob, *whether*. The infinitive on which this clause depends must be supplied; some such phrase as um zu ſehen, *in order to find out*. (15) Mund—here, *speech* or *conversation*. (16) daß, *so that*. (17) was is the subject and die Welt the object. (18) ſchau, *see* (1). (19) Samen is an old alchemistic expression for vital principle. This and the foregoing words are perhaps best rendered by "creative power" and "germ of life." (20) tu' . . . kramen—this use of tun, as an auxiliary, like the English *do*, is found in older literary writings, but is confined in the modern tongue to certain dialects only spoken by the uneducated. It should in no circumstances be imitated by the student. (21) ſäheſt, the Conjunctive to express a wish. In this stanza Faust apostrophises the moon. (22) den refers to Mondenſchein. (23) herangewacht; heran here indicates the gradual approach of the moonlight; thus, den Mondesſchein heranwachen, *to remain awake*, or to watch through the night until the moonlight draws nigh. (24) könnt', *see* (21). (25) Notice the contracted forms of Bergeshöhn and gehn. (26) Bergeshöhle—the singular used without an article in a plural sense. (27) entladen is Past Part. (28) ſich geſund baden, *to bathe* so as to become whole and sound.

The rhymes between the long **i** and long **ü**—e.g Medicin and Bemühn—and between long **e** and long **ö**—e.g. Bergeshöhn and gehn—are fairly common in all German verse, especially when the poets (as is mostly the case) are natives of the more southern parts of Germany.

The spelling in the above extract has to a small extent been modernised.

VOCABULARY

lie down, ſich hinlegen, w.
about, ungefähr.
distant, entfernt.
attendant, Begleiter, s.m.1.
needs, notwendiger Weiſe.
before, ehe.
for some time, eine Zeit lang.
think, denken, w.
enemy, Feind, s.m.2.
provided, vorausgeſetzt daß.
defend, verteidigen w.
baying, Bellen, s.n.1.
trace, verfolgen, w.
along with, bei.
to, um.
reflect, ſich überlegen.
shepherd's dog, Schäferhund, s.m.2.
place, Ort, s.m.3.
mile, Meile, w.f.
while, während.
watch, bewachen w.
pass, gehen, s.
come to, erreichen, w.
look at, anſehen, s. sep.
easily, leicht.
to keep from, verhindern, w.
bravely, tapfer.
at a distance, in der Ferne.
bloodhound, Schweißhund, s.m.2.
step, Spur, w.f.
guide, führen, w., leiten, w.
awaken, wecken, w.

Exercise 56 (*continued from* 54)

Bruce caused[1] his men to lie down to[2] take some sleep at a place about half[3] a mile distant[4] from the river, while he himself, with two attendants, went down to watch the ford, through which the enemy must needs pass before they could come to the place where King Robert's men were lying. He stood for some time looking[5] at the ford, and thinking how easily the enemy[6] might be kept from passing there, provided it was bravely defended, when[7] he heard at a distance the baying of a hound, which was always coming nearer and nearer. This was the bloodhound which was tracing the king's steps to[8] the ford, and the two hundred Galloway[9] men were along with the animal, and guided by it. Bruce at first thought of[10] going back to awaken his men; but then he reflected that it might[11] be only some shepherd's dog.

NOTES:

(1) Caused . . . down—say "let his men (Leute) lie down to sleep some." (2) To, um, followed by the infinitive with zu. (3) Half a mile, say "a half mile." (4) Distant, entfernt, being a Past Part., must be put at the end. (5) Looking . . .; say "looked at the ford and thought to himself" (bei ſich). (6) Enemy . . . kept; say "one could keep the enemy therefrom to go through the same." (7) When, da. (8) To, nach. (9) Say "men of Galloway." (10) Thought of, dachte daran, followed by the Infinitive with zu. (11) Might, dürfte.

Key to Exercise 53

But I still lived in the dream of the preceding night, which I could not expel from my mind. It was the old fairy tale of how a knight descends into a deep well, in the depths of which (where below) the most beautiful princess is bewitched into a deep (stiff) magic sleep. I myself was the knight, and the well was the Klaustal mine, and suddenly many lights appeared, the watchful little dwarfs rushed out from all the holes at the side, grimaced angrily, struck at me with their short swords, blew their horns shrilly (blew shrilly into the horn), so that always more and more hurried up, and their wide heads wagged horribly. It was only when I struck at them and the blood flowed that I noticed that they were the red blooming, long-bearded thistle heads which I had struck off with my stick the day before on the high road. Thereupon they all immediately disappeared (they were immediately driven away), and I reached a light, magnificent hall; in the middle, veiled in white, and stiff and motionless as a statue, stood my heart's delight, and I kissed her lips. . . . I seemed to hear (it seemed to me as if I heard) God exclaim: Let there be light! a dazzling beam of eternal light shot down (a beam shot down dazzlingly); but at the same moment it grew dark (night) again and everything was dissolved (ran together) in a wild and desolate sea. A wild and desolate sea! Over the boiling (fermenting) waters sped fearfully the ghosts of the dead, their white shrouds fluttered in the wind in their wake, hounding them on; with cracking whip ran a harlequin in many colours, and I myself was he—and suddenly, from out of the dark waves, the sea-monsters stretched their misshapen heads and reached out at me with outspread claws, and in (from) horror I awoke.

Key to Exercise 54

Der gute König Robert Bruce, der immer wachſam und vorſichtig war, hatte Nachricht bekommen von dem Vorhaben dieſer Partei ihn plötzlich und in der Nacht zu überfallen. Er ſtationierte alſo ſeine kleine Truppe von ſechzig Mann bei einem tiefen, reißenden Strom, deſſen Ufer ſehr ſteil und felſig waren. Der Fluß hatte in der Gegend nur eine Furte, durch welche man ihn paſſieren konnte, und jene Furte war tief und eng, ſo daß zwei Männer kaum neben einander durchkommen konnten. Der Pfad, der von dem Rande des Waſſers nach dem Ufer führte, war ſehr eng und ſchwierig.

M. A. L.

RUSSIAN.—XIV

The Verb

158. *The Subjunctive and Conditional Moods* are expressed in Russian by the particle бы, which is invariably placed before or after any verb in the Past Tense.

Examples

Я бы хо́тѣлъ знать,	*I should like to know.*
Мы бы Ва́мъ сове́товали,	*we should advise you.*
Вы бы могли́ э́то сдѣлать,	*you could do this.*

159. *The Passive Form of the Present Tense* is borrowed from the 1st Person Plural of the Present Tense by rejecting the Pronoun „Мы."

Examples

Мы фабрику́емъ,	*we are manufacturing.*
Фабрику́емъ,	*is being manufactured.*
Мы уважа́емъ,	*we respect.*
Уважа́емъ,	*is being respected.*
Мы цѣни́мъ,	*we appreciate, value.*
Цѣни́мъ,	*is appreciated, valued.*
Мы дорожи́мъ,	*we prize.*
Дорожи́мъ,	*is prized.*

160. Passive verbs play the same part as the predicative Adjectives (see Rule 147), and have the same endings with respect to Genders and Numbers.

Examples

Онъ почита́емъ въ о́бществѣ,	*he is respected in Society.*
Она́ всѣми почита́ема,	*she is respected by all.*
Оно́ почита́емо немно́гими,	*it is held in esteem by a few.*
Они́ почита́емы вездѣ,	*they* (m.) *are held in esteem everywhere.*
Онѣ почита́емы въ своёмъ кружкѣ.	*they* (f.) *are respected in their circle.*

161. Similarly to predicative Adjectives the passive verbs have degrees of comparison.

Examples

Онъ люби́мъ,	*he is liked.*
Онъ ненави́димъ,	*he is hated.*
Она́ люби́мѣе,	*she is more liked.*
Она ещё бо́лѣе нена-ви́дима,	*she is hated still more.*

162. In conjunction with other verbs the passive verbs are used for expressing states or events in the Past or Future Tenses.

Examples

Зада́ча была́ не рѣши́ма,	*the problem could not be solved* (was not solvable).
Положе́ніе бы́ло невыноси́мо,	*the position was unbearable*
Э́то бу́детъ зави́симо отъ обстоя́тельствъ,	*this will depend* (will be dependent) *on circumstances.*

163. *The Passive Form of the Past Tense* is formed from the Indicative Mood in the Past Singular by modifying its endings in numerous ways. The student is advised to study carefully the following examples by taking precise note of the endings in the Indicative and their respective transformations to form the Passive.

Examples

Онъ прерва́лъ сноше́нія (pl.),	*he severed the connection.*
Сноше́нія пре́рваны (pl.),	*the connection is severed.*
Онъ его́ вы́ругалъ,	*he has abused* (scolded) *him.*
Онъ былъ вы́руганъ,	*he was abused.*
Онъ про́далъ това́ръ,	*he sold the goods.*
Това́ръ про́данъ,	*the goods are sold.*
Онъ прижа́лъ его́ къ стѣнкѣ,	*he pressed him to the wall.*
Онъ былъ прижа́тъ къ стѣнкѣ,	*he was pressed to the wall.*
Онъ мнѣ сказа́лъ,	*he told me.*
Мнѣ бы́ло ска́зано,	*I was told.*
Ткачъ наткалъ ба́рхатъ,	*the weaver has finished weaving the velvet.*
Ба́рхатъ на́ткань,	*the velvet is woven.*
Онъ сдѣлалъ про́махъ,	*he made a blunder.*
Про́махъ былъ сдѣланъ,	*a blunder was made.*
Онъ слома́лъ па́лку,	*he broke the stick.*
Па́лка сло́мана,	*the stick is broken.*
Онъ забра́лъ свой чемода́нъ,	*he took away his travelling bag.*
Чемода́нъ за́бранъ,	*the travelling bag is taken away.*
Я написа́лъ письмо́,	*I have written a letter.*
Письмо́ напи́сано,	*the letter is written.*
Я зарабо́талъ хоро́шія де́ньги,	*I have earned good money.*
Де́ньги че́стно зарабо́таны,	*the money is honestly earned.*
Мы слыха́ли подо́бныя ве́щи,	*we heard such things.*
Э́ти ве́щи неслы́ханы,	*these are unheard-of things.*
Я на́чалъ но́вое де́ло,	*I have begun a new thing.*
Де́ло то́лько что на́чато,	*the thing has just begun.*
Я на́нялъ кора́бль,	*I have chartered* (hired) *a vessel.*
Кора́бль на́нятъ,	*the vessel is chartered* (hired).
Онъ погуби́лъ де́ло,	*he has ruined the business.*
Де́ло погу́блено,	*the business is ruined.*
Онъ переби́лъ разгово́ръ,	*he has interrupted the conversation.*
Разгово́ръ переби́тъ,	*the conversation is interrupted.*
Онъ забы́лъ число́,	*he has forgotten the date.*
Число́ забы́то,	*the date is forgotten.*
Онъ отпра́вилъ това́ръ,	*he has sent off the goods.*
Това́ръ отпра́вленъ,	*the goods are sent off.*

Онъ развилъ дѣло,	*he has developed the business.*
Дѣло развито,	*the business is developed.*
Онъ подтвердилъ телеграмму,	*he has confirmed the telegram.*
Телеграмма подтверждена,	*the telegram is confirmed.*
Онъ снабдилъ себя товаромъ,	*he has provided himself with goods.*
Онъ снабженъ товаромъ,	*he is provided with goods.*
Онъ нажилъ состояніе,	*he has made a fortune.*
Состояніе нажито,	*a fortune is made.*
Онъ наложилъ запрещеніе,	*he has put an embargo on.*
Запрещеніе наложено,	*an embargo is put on.*
Онъ опредѣлилъ цѣну,	*he has fixed the price.*
Цѣна опредѣлена,	*the price is fixed.*
Онъ отлилъ модель,	*he has cast a model.*
Модель отлита,	*the model is cast.*
Онъ меня изумилъ,	*he has astonished me.*
Я былъ изумленъ,	*I was astonished.*
Онъ смылъ пятно,	*he has washed off the stain.*
Пятно смыто,	*the stain is washed off.*
Онъ объяснилъ причину,	*he has explained the cause.*
Причина объяснена,	*the cause is explained.*
Онъ купилъ товаръ,	*he bought the goods.*
Товаръ купленъ,	*the goods are bought.*
Онъ выпилъ рюмку вина,	*he has drunk a glass of wine.*
Рюмка выпита,	*the glass of wine is emptied* (drunk).
Онъ меня увѣрилъ объ этомъ,	*he has assured me of this.*
Я въ томъ увѣренъ,	*I am sure of this.*
Я открылъ дѣло,	*I have opened a business.*
Дѣло открыто,	*the business is opened* (established).
Я взвѣсилъ обстоятельства,	*I have weighed up the circumstances.*
Обстоятельства взвѣшены,	*the circumstances are weighed up.*
Онъ не обратилъ вниманія,	*he has taken no notice.*
Вниманіе не обращено,	*notice is not taken.*
Я не получилъ товара,	*I have not received the goods.*
Товаръ не полученъ,	*the goods are not received.*
Онъ рѣшилъ вопросъ,	*he has solved the question.*
Вопросъ рѣшенъ,	*the question is solved.*
Онъ принесъ письмо,	*he brought a letter.*
Письмо принесено,	*the letter is brought.*
Онъ ввелъ новый порядокъ,	*he has introduced a new system.*
Новый порядокъ введенъ,	*a new system is introduced.*
Я разсмотрѣлъ образцы,	*I have examined the samples.*
Образцы разсмотрѣны,	*the samples are examined* (have been examined).
Я пріобрѣлъ сей домъ,	*I have acquired this house.*
Домъ пріобрѣтенъ мною,	*the house is acquired by me.*

N.B.—The Rules 160-162 apply also to the passive verbs in the Past Tense.

VOCABULARY

Радъ, *glad.*
Вступить, *to enter.*
Торговыя сношенія, *business relations.*
Если, *if.*
Предоставить, *to allow, grant.*
Долгосрочный, *long-termed, long-dated.*
Дать, *to give.*
Право, *the right.*
Дозволять, *to allow, admit, permit.*
Только, *only.*
Отступленіе, *a deviation.*
Правило, *rule.*
Разрѣшить, *to allow, permit.*
Лишь, *only.*
Правленіе, *Board of Directors, Headquarters.*
Сильно, *strongly, very much.*
Заинтересовать, *to interest.*
Походатайствовать, *to make representations.*
Передъ, *before, at.*
Наличный разсчётъ, *cash.*
Назначить, *to fix, make.*
Исключительный, *exceptional.*
Который, *which, who.*
Возможность, *possibility, chance.*
Одержать верхъ, *to get the upper hand.*
Надъ, *over, above.*
Конкурренція, *the competition, competitors.*
Совсѣмъ не, *not at all.*
Приманка, *a bait, enticement.*
Устрашать, *to frighten.*
Долгій, *long.*
Срокъ, *term.*
Разумѣть, *to understand, mean.*
Подъ, *under.*
Отъ, *from.*
До, *to.*
Девять, *nine.*
Пятнадцать, *fifteen.*
Первый разъ, *first time.*
Слышать, *to hear.*
Подобный, *similar, such.*
Отпускать, *to give, sell.*
Ярмарка, *the fair.*
Значить, *to mean.*
Ровно, *just.*
Двѣнадцать, *twelve.*
Урожай, *harvest.*
Восемнадцать, *eighteen.*
Больше, *more.*
На такихъ же, *on the very same.*
И, *also.*
Никогда, *never.*
Стѣснять, *to inconvenience.*
Поэтому, *therefore.*
Такъ, *so.*
Липнуть, *to stick to, adhere to.*
Ни за что, *for no price, not at any price.*
Ждать, *to wait.*
Долгъ, *the debt.*
Ещё, *another.*
Свѣжій, *fresh.*
Отослать, *to send off.*
Прибавить, *to add.*
Десять, *ten.*
Прошлый, *last.*
Недѣля, *week.*
Наложить платежъ, *to collect on delivery.*
Половина, *the half.*
Стоимость, *the value.*
Вексель, *bill of exchange.*
Срочный, *due.*
Перваго Февраля, *first of February.*
Передать, *to hand over.*
Мною, *by me.*
Для инкассо, *for collection.*
Петроградскій Купеческій Банкъ, *the Petrograd Merchants' Bank.*
Выставить переводъ, *to draw, to issue a draft.*
Отозвать, *to call back, revoke.*
Иначе, *otherwise.*
Предвидѣть, *to foresee.*
Оправдать, *to meet, honour, justify, pay.*
Отсрочить, *to prolong, defer.*
Отсрочка, *the prolongation, deferring.*
Получиться, *to be received.*
Съ поврежденіемъ, *damaged, with damage.*
Оставить, *to leave.*
Распоряженіе, *disposal.*
Отвѣтственны, *responsible.*
Случившееся, *what happened.*
Въ путь, *on the road.*
За Вашъ собственный счётъ и рискъ, *at your own risk and responsibility.*
Тѣмъ не менѣе, *none the less.*
Не прочь, *not disinclined, not having any objection.*
Удовлетворить, *to indemnify.*
Какъ нибудь, *in some way.*
За убытки, *for the damage.*
Узнать, *to get to know.*
Дѣла, *the affairs.*
Блестящи, *bright.*
Поэтому, *therefore.*
Рекомендовать, *to recommend.*
Принимать, *to take.*
Предосторожность, *precaution.*
Считать долгомъ, *to deem a duty.*
Обанкрутиться, *to go bankrupt.*
Небрежное, *neglectful, careless.*
Веденіе, *management.*
Интересъ, *interest.*

Перейти́, *to go over.*
Другóй, *another.*
Объясни́ть, *to explain.*
Причи́на, *the cause, reason.*
У насъ, *ours is.*
Земледѣльческій, *agricultural.*
Страна́, *country.*
Потреби́тель, *consumer.*
Цѣлый годъ, *the whole year.*
Забира́ть, *to take, get.*
Безъ де́негъ, *without pay.*
Распла́чиваться, *to settle.*
За всё, *for the bulk.*
По́слѣ, *after.*
а, *but, and.*
Быва́ть, *to happen to be.*
Тогда́, *then.*
Приходи́ться, *to be driven to the necessity.*
Наблюда́ть за (Instr.), *to look after.*
Повѣренный, *councillor, trustee, solicitor, attorney.*
Судъ, *the Court.*
Объявя́ть, *to declare, announce.*
Зло́стный банкро́тъ, *fraudulent, bankrupt.*
Тепе́рь, *now.*
Арестова́ть, *to arrest.*
Иму́щество, *the goods.*
Переда́ть, *to hand over.*
Ко́нкурсное Управле́ніе, *Board of Administration.*
Пасси́вы, *the liabilities.*
Превыша́ть, *to exceed.*
Милліо́нъ, *a million.*

Exercise 24

1. Я бы́ть бы ра́дъ вступи́ть съ Ва́ми въ торго́выя сноше́нія, е́сли бы Вы могли́ мнѣ предоста́вить долгоро́чный креди́тъ.

2. Мнѣ бы́ло дано́ пра́во дозволя́ть то́лько три и́ли четы́ре мѣсяца креди́та.

3. Отступле́ніе отъ сего́ пра́вила мо́жетъ быть разрѣшено́ лишь правле́ніемъ.

4. Я си́льно заинтересо́ванъ Ва́шей фи́рмой и я походата́йствую о Васъ пере́дъ мои́мъ правле́ніемъ.

5. Не мо́жете ли Вы заказа́ть у меня́ пока́мѣсть что нибу́дь за нали́чный разче́тъ?

6. Я Вамъ назна́чу исключи́тельныя цѣны, кото́рыя даду́тъ Вамъ возмо́жность одержа́ть верхъ надъ конкурре́нціей.

7. Дѣшевыя цѣны для меня́ совсѣмъ не приме́нка а конкурре́нція меня́ не устраша́етъ.

8. Мнѣ ну́жны то́лько двѣ ве́щи: до́брый това́ръ и до́лгіе сро́ки.

9. Что Вы разумѣете подъ до́лгими сро́ками?

10. Отъ девяти́ до пятнадцати́ мѣсяцевъ.

11. Я въ пе́рвый разъ слы́шу о подо́бныхъ сро́кахъ.

12. На́ши фабрика́нты отпуска́ютъ това́ръ съ я́рмарки до я́рмарки.

13. Э́то зна́читъ ро́вно двѣна́дцать мѣсяцевъ, а въ плохо́й урожа́й восемна́дцать мѣсяцевъ и бо́льше.

14. На таки́хъ же усло́віяхъ я отпуска́ю това́ръ и мои́мъ покупа́телямъ.

15. Я никогда́ не стѣсня́ю ихъ ни деньга́ми, ни това́ромъ.

16. Поэ́тому они́ такъ ли́пнутъ ко мнѣ и ни за что не перейду́тъ къ друго́й фи́рмѣ.

17. Не мо́жете ли объясни́ть причи́ну таки́хъ до́лгихъ креди́товъ?

18. У насъ земледѣльческая страна́. Потреби́тели цѣлый годъ забира́ютъ това́ръ безъ де́негъ и распла́чиваются за всё по́слѣ урожа́я.

19. А е́сли урожа́й быва́етъ плохо́й?

20. Тогда́ прихо́дится ждать потреби́телю долгъ ещё годъ и дава́ть ему́ свѣжій креди́тъ.

Exercise 25

1. If my order has not been sent off yet, could you not add to it ten pieces more (ещё) of the cloth F.?

2. Your order has been sent off last week.

3. Make a shipment (отпра́вка) of (въ) twenty-five pieces and collect half of the value (on delivery) through the bank.

4. Your bill of exchange due on February first has been handed over by me for collection to the Petrograd Merchants' Bank.

5. We have issued a draft on you for (на) five hundred roubles.

6. Call the draft back (revoke the draft); otherwise it will be dishonoured (не опра́вданъ).

7. I do not foresee the possibility of meeting (to meet) my bill due in (че́резъ) a month.

8. Your bill has been deferred by me for (на) three months.

9. I thank you for the prolongation.

10. Your goods have been received damaged.

11. I have placed it at your disposal.

12. We cannot be responsible for what has happened on the road.

13. The goods have been sent out at your own risk and responsibility.

14. We are none the less not disinclined to indemnify you in some way for the damage.

15. I have got to know that the affairs of the firm B. are not bright, and I therefore recommend you to take precautions.

16. I deem it my (споймъ) duty to inform you that D. Brothers have gone bankrupt. The cause is careless management of affairs.

17. Your interests are looked after by the solicitor Mr. M. (The solicitor, Mr. M., is looking after your interests.)

18. The Court has declared the Brothers D. as being fraudulent bankrupts.

19. Both brothers are arrested, and the goods have been handed over to a Board of Administration.

20. It is said that their liabilities exceed one million roubles. A. C.

GREEK.—II

First Declension

THE stems of nouns of this declension end in α, which is often modified into η. The nominative singular of feminine nouns ends in α or η, that of masculine nouns in $-\alpha\varsigma$ or $-\eta\varsigma$.

I.—Feminine Nouns.

The nouns $\tau\iota\mu\acute{\eta}$, *honour;* $\chi\acute{\omega}\rho\alpha$, *land;* and $\Mo\tilde{\upsilon}\sigma\alpha$, *muse;* are declined as follows:—

	Singular.		
Nom.	ἡ τιμ-ή	ἡ χώρ-α	ἡ Μοῦσ-α
Gen.	τῆς τιμ-ῆς	χώρ-ας	Μούσ-ης
Dat.	τῇ τιμ-ῇ	χώρ-ᾳ	Μούσ-ῃ
Acc.	τὴν τιμ-ήν	χώρ-αν	Μοῦσ-αν
Voc.	ἡ τιμ-ή	χώρ-α	Μοῦσ-α
	Plural.		
Nom.	αἱ τιμ-αί	χῶρ-αι	Μοῦσ-αι
Gen.	τῶν τιμ-ῶν	χωρ-ῶν	Μουσ-ῶν
Dat.	ταῖς τιμ-αῖς	χώρ-αις	Μούσ-αις
Acc.	τὰς τιμ-άς	χώρ-ᾱς	Μούσ-ας
Voc.	αἱ τιμ-αί	χῶρ-αι	Μοῦσ-αι
	Dual.		
N.A.V.	τὼ τιμ-ά	χώρ-α	Μούσ-α
G.D.	τοῖν τιμ-αῖν	χώρ-αιν	Μούσ-αιν

When the nom. sing. ends in α preceded by ϵ, ι, or ρ, α is retained throughout the singular, as in $\chi\acute{\omega}\rho\alpha$. This is so again in some proper names. Other nouns ending in α in the nom. sing. are declined like $\Mo\tilde{\upsilon}\sigma\alpha$.

Nouns ending in $\alpha\alpha$ and $\epsilon\alpha$, e.g. $\sigma\upsilon\kappa\acute{\epsilon}\alpha$, $\sigma\upsilon\kappa\tilde{\eta}$, *fig-tree*, and $\mu\nu\acute{\alpha}\alpha$, $\mu\nu\tilde{\alpha}$, *mina*, are contracted thus:—

	Singular.	
Nom.	ἡ (συκέ-α) συκ-ῆ	ἡ (μνά-α) μν-ᾶ
Gen.	(συκέ-ας) συκ-ῆς	(μνά-ας) μν-ᾶς
Dat.	(συκέ-ᾳ) συκ-ῇ	(μνά-ᾳ) μν-ᾷ
Acc.	(συκέ-αν) συκ-ῆν	(μνά-αν) μν-ᾶν
Voc.	(συκέ-α) συκ-ῆ	(μνά-α) μν-ᾶ
	Plural.	
Nom.	(συκέ-αι) συκ-αῖ	(μνά-αι) μν-αῖ
Gen.	(συκέ-ων) συκ-ῶν	(μνα-ῶν) μν-ῶν
Dat.	(συκέ-αις) συκ-αῖς	(μνά-αις) μν-αῖς
Acc.	(συκέ-ας) συκ-ᾶς	(μνά-ας) μν-ᾶς
Voc.	(συκέ-αι) συκ-αῖ	(μνά-αι) μν-αῖ
	Dual.	
N.A.V.	(συκέ-α) συκ-ᾶ	(μνά-α) μν-ᾶ
G.D.	(συκέ-αιν) συκ-αῖν	(μνά-αιν)μν-αῖν

II.—Masculine Nouns.

The nouns πολίτης, *citizen*, and νεανίας, *young man*, and the contracted noun Ἑρμέας, Ἑρμῆς, *Hermes* or *Mercury*, are declined as follows:—

	Singular.			
Nom.	ὁ πολίτης	ὁ νεανίας	ὁ (Ἑρμέας)	Ἑρμῆς
Gen.	πολίτου	νεανίου	(Ἑρμέου)	Ἑρμοῦ
Dat.	πολίτῃ	νεανίᾳ	(Ἑρμέᾳ)	Ἑρμῇ
Acc.	πολίτην	νεανίαν	(Ἑρμέαν)	Ἑρμῆν
Voc.	πολῖτα	νεανίᾰ	(Ἑρμέα)	Ἑρμῆ
	Plural.			
Nom.	πολῖται	νεανίαι	(Ἑρμέαι)	Ἑρμαῖ
Gen.	πολιτῶν	νεανιῶν	(Ἑρμῶν)	Ἑρμῶν
Dat.	πολίταις	νεανίαις	(Ἑρμέαις)	Ἑρμαῖς
Acc.	πολίτᾱς	νεανίᾱς	(Ἑρμέας)	Ἑρμᾶς
Voc.	πολῖται	νεανίαι	(Ἑρμέαι)	Ἑρμαῖ
	Dual.			
N.A.V.	πολίτᾱ	νεανίᾱ	(Ἑρμέα)	Ἑρμᾶ
G.D.	πολίταιν	νεανίαιν	(Ἑρμέαιν)	Ἑρμαῖν

Nouns ending in -της, national names like Πέρσης, *a Persian*, and compounds like γεω-μέτρης, *geometrician*, or μυρο-πώλης, *perfumer*, have the vocative singular in α, as Πέρσᾰ, γεωμέτρα, and μυροπῶλα. Most others have the vocative in η, as Κρονίδης, *son of Kronos*, voc. sing. Κρονίδη.

Second Declension

The stems of nouns of this declension end in ο, which is sometimes lengthened to ω. The nominative singular usually ends in -ος or -ον. Nouns in -ος are masculine (with a few exceptions of the feminine gender), those in -ον neuter.

The nouns λόγος, *word*; θεός, *god*; ἄγγελος, *messenger*; and σῦκον, *fig*, are declined as follows:

	Singular.			
Nom.	ὁ λόγος	ὁ, ἡ ἄγγελος	ὁ, ἡ Θεός	τὸ σῦκον
Gen.	λόγου	ἀγγέλου	Θεοῦ	σύκου
Dat.	λόγῳ	ἀγγέλῳ	Θεῷ	σύκῳ
Acc.	λόγον	ἄγγελον	Θεόν	σῦκον
Voc.	λόγε	ἄγγελε	Θεός	σῦκον
	Plural.			
Nom.	λόγοι	ἄγγελοι	Θεοί	σῦκα
Gen.	λόγων	ἀγγέλων	Θεῶν	σύκων
Dat.	λόγοις	ἀγγέλοις	Θεοῖς	σύκοις
Acc.	λόγους	ἀγγέλους	Θεούς	σῦκα
Voc.	λόγοι	ἄγγελοι	Θεοί	σῦκα
	Dual.			
N.A.V.	λόγω	ἀγγέλω	Θεώ	σύκω
G.D.	λόγοιν	ἀγγέλοιν	Θεοῖν	σύκοιν

Note that Θεός, like Latin *Deus*, God, has the same form for the voc. and the nom. sing.

A few masculine and feminine nouns belong to what is called the Attic Declension: νεώς, *temple*, and ἄλως, *threshing-floor*, are declined as follows:

	Singular.	
Nom.	ὁ νεώς	ἡ ἄλως
Gen.	νεώ	ἄλω
Dat.	νεῴ	ἄλῳ
Acc.	νεών	ἄλων
Voc.	νεώς	ἄλως
	Plural.	
Nom.	νεῴ	ἄλῳ
Gen.	νεών	ἄλων
Dat.	νεῴς	ἄλῳς
Acc.	νεώς	ἄλως
Voc.	νεῴ	ἄλῳ
	Dual.	
N.A.V.	νεώ	ἄλω
G.D.	νεῴν	ἄλῳν

Adjectives of the First and Second Declensions.

The adjective agrees in gender, number, and case with its substantive in Greek as in Latin, and accordingly has a three-fold gender. Many adjectives have, however, only two terminations, one for both the masculine and the feminine, and one for the neuter. But most adjectives in -ος have three terminations, -ος, -η, and -ον. Those in masculine and neuter are declined like nouns of the second declension, those in the feminine like nouns of the first declension, as ἀγαθός, ἀγαθή, ἀγαθόν, *good*.

If a vowel or ρ precedes the -ος of the nom. sing. masc. the feminine ends in α, as in φίλιος, φιλία, φίλιον, *friendly*. But adjectives in -ους have -οα in the feminine only when ο is preceded by ρ; otherwise they end in -οη; thus ἄθρους, ἀθρόα, ἀθρόον, *dense*, ὄγδοος, ὀγδόη, ὄγδοον, *eighth*.

Σοφός, σοφή, σοφόν, *wise*, and φίλιος, φιλία, φίλιον, *friendly*, are declined as follows:

	Singular.					
	M.	*F.*	*N.*	*M.*	*F.*	*N.*
Nom.	σοφός	-ή	-όν	φίλιος	-ία	-ιον
Gen.	σοφοῦ	-ῆς	-οῦ	φιλίου	-ίας	-ιου
Dat.	σοφῷ	-ῇ	-ῷ	φιλίῳ	-ίᾳ	-ίῳ
Acc.	σοφόν	-ήν	-όν	φίλιον	-ίαν	-ιον
Voc.	σοφέ	-ή	-όν	φίλιε	-ία	-ιον
	Plural.					
Nom. Voc.	σοφοί	-αί	-ά	φίλιοι	-ιαι	-ια
Gen.	σοφῶν	-ῶν	-ῶν	φιλίων	-ίων	-ίων
Dat	σοφοῖς	-αῖς	-οῖς	φιλίοις	-ίαις	-ίοις
Acc.	σοφούς	-άς	-ά	φιλίους	-ίᾱς	-ια
	Dual.					
N.A.V.	σοφώ	-ά	-ώ	φιλίω	-ία	-ίω
G.D.	σοφοῖν	-αῖν	-οῖν	φιλίοιν	-ίαιν	-ίοιν

We here give three nouns of the first declension, and then two of the second declension, accompanied by adjectives (all of three terminations) declined in the singular number. The student would do

well to write down the dual and plural in each case.

Singular.

	fair honour.	*just opinion.*	*hateful land.*
Nom.	καλὴ τιμή	δικαία γνώμη	ἐχθρὰ χώρα
Gen.	καλῆς τιμῆς	δικαίας γνώμης	ἐχθρᾶς χώρας
Dat.	καλῇ τιμῇ	δικαίᾳ γνώμῃ	ἐχθρᾷ χώρᾳ
Acc.	καλὴν τιμήν	δικαίαν γνώμην	ἐχθρὰν χώραν
Voc.	καλὴ τιμή	δικαία γνώμη	ἐχθρὰ χώρα

Singular.

	good word.	*good child.*
Nom.	ἀγαθὸς λόγος	ἀγαθὸν τέκνον
Gen.	ἀγαθοῦ λόγου	ἀγαθοῦ τέκνου
Dat.	ἀγαθῷ λόγῳ	ἀγαθῷ τέκνῳ
Acc.	ἀγαθὸν λόγον	ἀγαθὸν τέκνον
Voc.	ἀγαθὲ λόγε	ἀγαθὸν τέκνον

Adjectives of Two Terminations.

Adjectives of only two terminations are principally compounds, as πάγκαλος, -ον, *entirely beautiful* (πᾶν, *all*, καλός, *beautiful*), or ἀθάνατος, *immortal, deathless* (ἀ-, μη-, θάνατος, *death*). These are declined like σοφός, -όν, the feminine forms being omitted.

With these may be grouped some adjectives declined like the Attic second declension, as ἵλεως, -ων, *propitious*, thus :—

Singular.

	Masc.	*Fem.*	*Neut.*
Nom.	ἵλεως		ἵλεων
Gen.		ἵλεω	
Dat.		ἵλεῳ	
Acc.		ἵλεων	
Voc.	ἵλεως		ἵλεων

Plural.

Nom. Voc.	ἵλεῳ		ἵλεα
Gen.		ἵλεων	
Dat.		ἵλεως	
Acc.	ἵλεως		ἵλεα

Dual.

N.A.V.		ἵλεω	
G.D.		ἵλεῳν	

Contracted Nouns and Adjectives.

A number of nouns and adjectives ending in -εος, -εον, -οος, and -οον are contracted. Πλόος, πλοῦς, *voyage*, and ὀστέον, ὀστοῦν, *bone*, are declined as follows :—

Singular.

Nom.	ὁ (πλόος) πλοῦς	τὸ (ὀστέον) ὀστοῦν
Gen.	(πλόου) πλοῦ	(ὀστέου) ὀστοῦ
Dat.	(πλόῳ) πλῷ	(ὀστέῳ) ὀστῷ
Acc.	(πλόον) πλοῦν	(ὀστέον) ὀστοῦν
Voc.	(πλόε) πλοῦ	(ὀστέον) ὀστοῦν

Plural.

N.V.	(πλόοι) πλοῖ	(ὀστέα) ὀστᾶ
Gen.	(πλόων) πλῶν	(ὀστέων) ὀστῶν
Dat.	(πλόοις) πλοῖς	(ὀστέοις) ὀστοῖς
Acc.	(πλόους) πλοῦς	(ὀστέα) ὀστᾶ

Dual.

N.A.V.	(πλόω) πλῶ	(ὀστέω) ὀστώ
G.D.	(πλόοιν) πλοῖν	(ὀστέοιν) ὀστοῖν

Contracted adjectives of three terminations are declined on the following models, χρύσεος, *golden*, and ἁπλόος, *simple* :—

Singular.

	M.	*F.*	*N.*	*M.*	*F.*	*N.*
N.V.	χρυσοῦς	χρυσῆ	χρυσοῦν	ἁπλοῦς	ἁπλῆ	ἁπλοῦν
Gen.	χρυσοῦ	χρυσῆς	χρυσοῦ	ἁπλοῦ	ἁπλῆς	ἁπλοῦ
Dat.	χρυσῷ	χρυσῇ	χρυσῷ	ἁπλῷ	ἁπλῇ	ἁπλῷ
Acc.	χρυσοῦν	χρυσῆν	χρυσοῦν	ἁπλοῦν	ἁπλῆν	ἁπλοῦν

Plural.

N.V.	χρυσοί	χρυσαῖ	χρυσᾶ	ἁπλοῖ	ἁπλαῖ	ἁπλᾶ
Gen.	χρυσῶν	χρυσῶν	χρυσῶν	ἁπλῶν	ἁπλῶν	ἁπλῶν
Dat.	χρυσοῖς	χρυσαῖς	χρυσοῖς	ἁπλοῖς	ἁπλαῖς	ἁπλοῖς
Acc.	χρυσοῦς	χρυσᾶς	χρυσᾶ	ἁπλοῦς	ἁπλᾶς	ἁπλᾶ

Dual.

N.A.V.	χρυσώ	χρυσᾶ	χρυσώ	ἁπλώ	ἁπλᾶ	ἁπλώ
G.D.	χρυσοῖν	χρυσαῖν	χρυσοῖν	ἁπλοῖν	ἁπλαῖν	ἁπλοῖν

Adjectives ending in -εος, contract the fem. sing. into ᾶ if -εος is preceded by a vowel or ρ as ἀργυρᾶ, ἀργυρᾶς, ἀργυρᾷ, ἀργυρᾶν, (uncontracted nom. sing. ἀργυρέα), *silver*.

Compound adjectives formed from νοῦς, *mind*, as εὐνοῦς, *well disposed* ; nom. πλοῦς, *voyage*, as εὔπλους, *voyaging successfully* ; or nom. ῥοῦς, *current* ; εὔρους, *fair-flowing* ; are of two terminations only, being declined like the masculine and neuter of ἁπλοῦς, except that they remain uncontracted in the nom. plur. neut., εὐνόα, εὐπλόα, εὐρόα.

VOCABULARY.

ἀδικία, ἡ,	*injustice.*	θαυμάζω,	*I admire.*
αἰσχύνη, ἡ,	*disgrace.*	κακῶς,	*ill, badly.*
ἀληθεύω,	*I speak the truth.*	καλῶς,	*well, beautifully.*
ἀνδρείως,	*bravely.*	καρδία, ἡ,	*the heart.*
βιοτεύω,	*I live.*	λύω,	*I undo, loose, dissipate.*
γράφω,	*I write.*	μάχομαι,	*I fight* (middle voice).
διώκω,	*I follow, pursue.*	μή,	(*do*) *not.*
εἰ,	*if.*	οὐ (οὐκ, οὐχ before vowels),	*not, no.*
ἐσθίω,	*I eat, consume.*	πιστεύω,	*I believe.*
ἔχω, ἔχει,	*I have.* (with adverb), *it is.*	φεύγω,	*I flee.*
εὖ ἔχει,	*it is well.*		
ἡδέως,	*sweetly, pleasantly.*	ψέγω,	*I blame.*

Exercise 1

Translate into English :—

1. Ἡ λύρα μερίμνας λύει. 2. Ἡ μέριμνα τὴν καρδίαν ἐσθίει. 3. Ἡδέως βιοτεύω. 4. Καλῶς γράφεις. 5. Ἀνδρείως μάχεται. 6. Εἰ ἀνδρείως μάχεσθε, θαυμάζεσθε.

Translate into Greek :—

1. Shun injustice, O young men. 2. You shun injustice. 3. Anxious cares are dissipated by the lyre. 4. He writes well. 5. If I speak the truth I am believed. 6. Do not fight (ye). E. A. B.

Continued from page 106.

GEOGRAPHY:

Contributors:—Robert Finch, F.R.G.S.; W. H. Koebel; Sir John Scott-Keltie, LL.D., Cyril J. Silverston, B.Sc.(Lond.).

AUSTRALASIA.—II

THE principal industries of Australia are mining, cattle- and sheep-breeding, and agriculture.

The mineral wealth of the continent, as at present known, is distributed principally along the territories of the east and the west. Western Australia possesses the most notable goldfields, the principal centres here being Ashburton and Pilbarra in the north, and Peak Hill, Murchison, Kalgoorlie, Coolgardie, and Southern Cross in the centre and south.

At the present time gold is less plentifully met with in the east, although very large quantities of this metal have been mined here in the past, and the names of Bendigo and Ballarat in Victoria are historical on this account. Mount Morgan in Queensland, too, more recently was responsible for a startlingly large output of gold.

Queensland is the chief producer of copper, the Mount Morgan mine being the most famous; but Cobar in New South Wales, and Tasmania both produce important quantities of copper. Tin is met with throughout the eastern highlands, as well as in Tasmania. One of the most remarkable instances of Australian mines is the famous Broken Hill in New South Wales. This has produced in turn tin, silver, lead, and is now concerned with an important output of zinc.

The principal coalfields occur in the eastern highlands, the most important area of all being in the neighbourhood of Sydney. There are also coalfields of lesser extent and value in Queensland, Tasmania, South Australia, and West Australia.

The relative values of these various Australian minerals will be seen from the recent figures of the annual output, which, roughly, amounted to nine and a half million pounds' worth of gold, four millions of coal, three and a half millions of silver-lead and bullion, three millions of copper, and over a million pounds' worth of lead.

The Australian livestock breeding industry is of immense importance, and the growing demand for meat which necessarily accompanies the increasing population of the world makes it practically certain that this national asset will become of still greater importance in the future.

Photo: by permission of the High Commissioner for Australia.

THE HARBOUR OF SYDNEY, the chief port of the Commonwealth, is one of the finest in the world.

is occasionally liable. Floods have from time to time wrought havoc, but the damage done by these has been insignificant compared with the ruin brought about by the droughts which have visited the country.

Owing to this reason there seems no doubt that twenty years ago New South Wales grazed twenty millions more sheep on its pastures than it does to-day, and it has been computed that the great drought of 1901-2 cost the whole of Australia nearly one hundred and thirty million pounds! Unfortunately, too, that particular drought has proved by no means the only one of its kind. The great pastoral country has, nevertheless, amply demonstrated its power to recover from even such evil seasons as these.

The three principal sheep-breeding states are New South Wales, Queensland, and Victoria, the first of these supporting nearly forty millions of sheep, the second half this amount, and the third half again. New South Wales holds the premier position as a horse-breeding state, supporting over seven hundred thousand, as it does.

Grazing and Agriculture

Horses, however, are far more evenly distributed over the continent than sheep, and South Australia and West Australia are both concerned to an important extent in this branch of the pastoral industry. In the matter of cattle the respective positions of the various states are somewhat different. Here Queensland comes first with over five millions; New South Wales grazes just over three millions, and Victoria a million and a half. The rest of the states together only support rather more than this last figure.

The climatic reasons for this distribution of livestock will readily be seen, for whereas cattle and horses will flourish up to a point in a country of tropical heat, the constitutions of sheep do not permit such a wide range of pastures, and these seldom thrive to any extent even in a land of which the conditions are merely sub-tropical.

The agriculture of Australia is varied, as may be readily imagined from the variety of the Commonwealth's climates. The general development of the European cereals has not been possible, of course. A valuable wheat belt, nevertheless, exists in New South Wales, Victoria, and the south-east of South Australia.

The growing of European fruits is carried on with great success in the south-east, Tasmania being especially famous for the growth of its apples, peaches, and similar

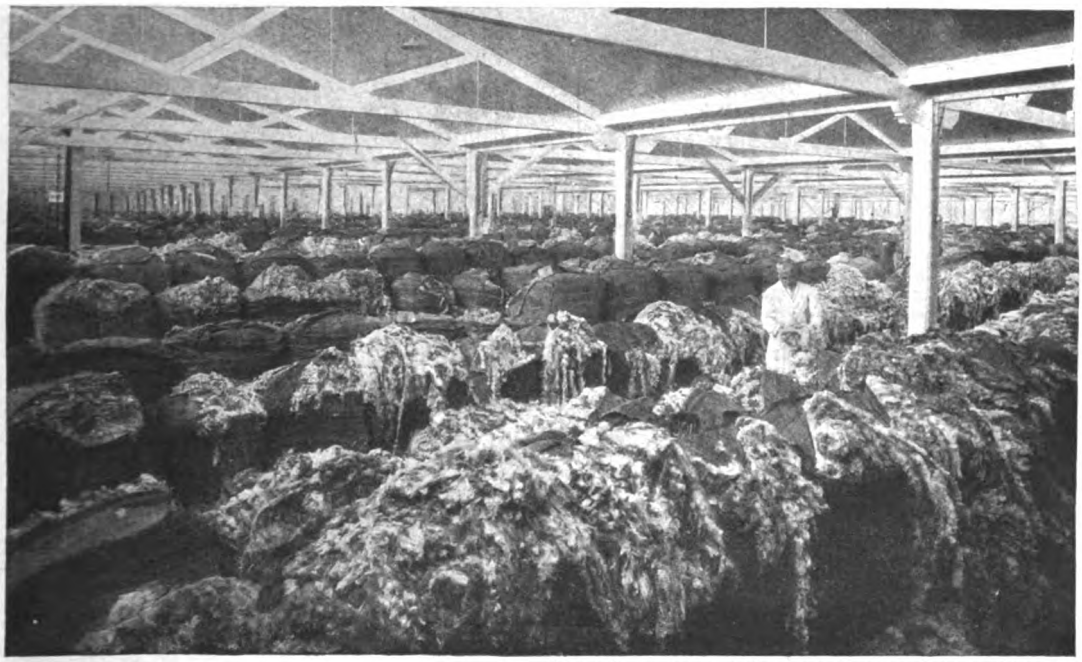


Photo: by permission of the Agent-General for South Australia.

WOOL STORE AT ADELAIDE,

the populous and growing capital of South Australia. The Commonwealth of Australia possesses something like 80,000,000 sheep.

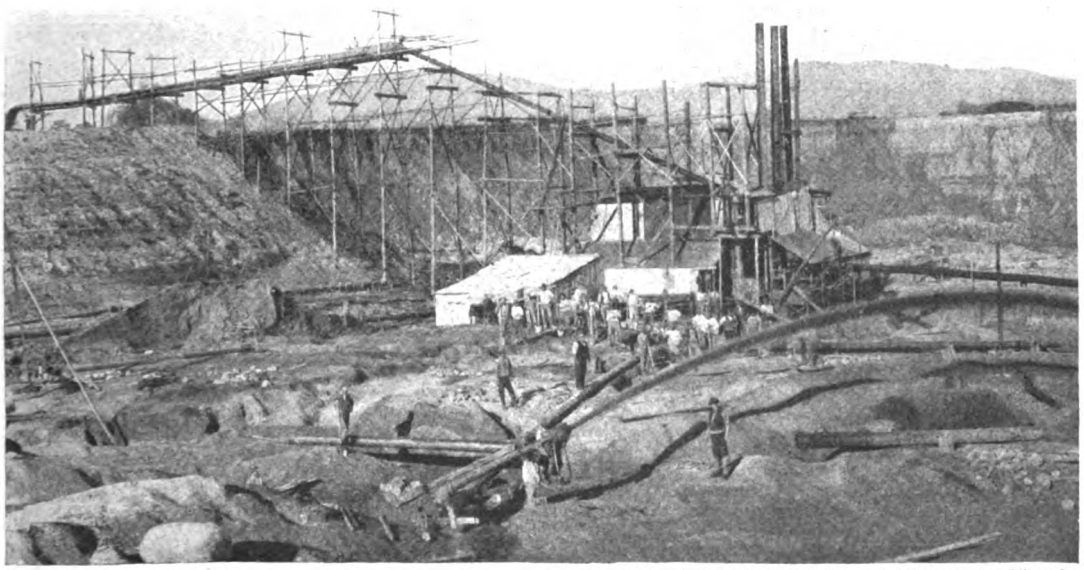


Photo: by permission of the Agent-General for Victoria

HYDRAULIC SLUICING FOR GOLD

in Victoria. The output of gold from Victoria is now much less than that from Western Australia. The old goldfields are also finding rivals in Queensland.

products. In the north the cultivation of the tropical fruits is now rapidly increasing in importance. In Queensland, for instance, large areas have now been placed under pineapples, that find a ready market in Brisbane. It is possible here on fresh soil to raise from one to fifteen tons of this fruit on an acre. The planting of sugar-cane, too, is now effected on an important scale in Queensland.

On the northern and tropical coasts there are various industries carried on which are not generally associated in the popular mind with the staple products of the Commonwealth. The population here is of a rather floating order, and is very mixed from a racial point of view. In the past much Kanaka labour has been imported, and there are many Polynesians and Malays, besides various tribes of aboriginals on the coast.

Native Industries

One of the chief industries here is that of the collection of the bêche-de-mer, or trepang, that is usually described in English as a sea-slug, or sea-cucumber. When these animals have been prepared and smoked they are exported to China, where they are considered a great delicacy.

These are collected by Malays, who sail over from Asia in their "proas," curious-looking craft provided with mat sails. Their skilled divers are accustomed to plunge into the warm waters, emerging with their arms full of trepang, while at other times the proas will dredge for the sea-slugs. When a sufficient quantity of these has been obtained the catch is taken to a "smoke house" erected on the shore, where it is treated before being taken to China for edible purposes.

Feuds have occasionally arisen between the Australian blacks and the Malays, with the result that more than one party of the adventurous Asiatics have been massacred.

The pearl industry off the northern Australian coast is carried on from luggers, manned as a rule by a crew of Malays, the pearl-seekers usually descending in regulation diving costume.

The chief areas of the timber industry are Western Australia and New South Wales. Some of the most valuable products in this respect are the eucalyptus oils. The Jarrah wood has already been referred to for its merits in the way of railway sleepers and paving blocks. The Karri wood serves for the same purposes. Some fine cabinet woods exist, of which the principal are cedar, rosewood and tulipwood.

The Commonwealth of Australia was proclaimed on New Year's Day, 1901. The legislature consists of a Governor-General, a senate of thirty-six members, and a house of seventy-five representatives. The members of the legislature receive six hundred pounds per annum, irrespective of whether they belong to the senate or to the house of representatives. Australia, it should be said, is a country in which women have the right to vote, as well as to be elected to the legislature.

The capital of the Commonwealth is Canberra. This spot was chosen in 1909, and it is therefore an infant among capitals. Its more imposing features still remain to be built; but the plan has been thoroughly mapped out, and in the end the city cannot but gain from having a free and unimpeded field on which to be constructed.

Of the older capitals, the beautifully situated and healthy port of Sydney, the capital of New South Wales, is the most populous, possessing some 777,500 inhabitants. Sydney is the chief port of the Commonwealth, and its harbour is one of the finest in the world. In the opinion of many it is only rivalled by Rio de Janeiro in Brazil. However this may be, it is certain enough that the enthusiasm of the Australians for the beauty and importance of Sydney is amply justified.

Melbourne

From the urban point of view Sydney's great rival in Australia is Melbourne, the capital of Victoria, which has a population of 708,500, and which is, therefore, very little smaller than the New South Wales capital. Melbourne is now acting as the temporary capital of the Commonwealth, and is a magnificent city, possessing a university and a number of splendid public buildings which many a first-class European town might have good reason to envy.

Brisbane, situated about twenty-five miles from the mouth of the Brisbane River, is the capital of Queensland. From the point of view of population it shows a considerable drop from the average of the first two, seeing that its inhabitants number 173,500. It possesses a university, however, and is an important commercial centre, being principally concerned with the export of frozen meat, tallow, and hides.

The capital of South Australia comes third in the order of populous importance, Adelaide having 237,750 inhabitants. It is of note both from a university and industrial

standpoint, and comes within the numerous category of the Australian cities of beauty. Its death-rate is remarkably low.

The importance of Perth, the capital of Western Australia, is rather more recent, for it was the discovery of the Coolgardie goldfields that has largely helped to bring this city to its present prominent situation. Its population is 130,000. It is situated on the Swan River, a dozen miles from the mouth, and possesses a seaport with a fine harbour in Fremantle.

Hobart

The last capital to be surveyed here is Hobart, the chief town of Tasmania. Its harbour is one of the finest even of that magnificent collection which the Australasian world can boast, and it is, moreover, surpassingly beautiful. It is one of the chief centres of the Tasmanian fruit industry.

Some other Australian towns of importance are : Newcastle, at the mouth of the Hunter River, a noted colliery port ; Parramatta, likewise in New South Wales, a fruit and vegetable centre, and Broken Hill, in the same state, famous for its goldfields. Other important mining centres are Ballarat, Bendigo, and Geelong in Victoria, whilst Kalgoorlie, its population of 31,000 being somewhat smaller than those of the previously mentioned three, is the headquarters of the E. goldfields of W. Australia.

As the nature of its development demands, the principal railways are in the south-east of the continent. The most important system is that which starts from Brisbane on the central east coast, and runs south to Newcastle and Sydney, then swerving inland to strike down to Melbourne, whence it proceeds north-westwards to Adelaide and from that point northwards to Port Augusta. This line has many ramifications, the great majority of which branch off from the south-east into the interior.

From the west coast a line now runs from Perth to Port Augusta via Kalgoorlie, a line which has the effect of linking together the west and the east coasts of southern Australia, and providing direct communication between Brisbane and Perth by way of the great urban centres of the south-east.

A Transcontinental Railway ?

A scheme which is still somewhat remote as regards its fulfilment is that of a railway to pierce the heart of the continent from north to south. A line already runs to the north from Port Augusta as far as Oodnadatta and in the tropical north a line runs to the south as far as Pine Creek. It is intended to prolong the two through the interior of the continent until they meet. This achievement cannot well fail to be an arduous and difficult one, but there is no doubt that it will be successfully completed in the end.

W. H. K.

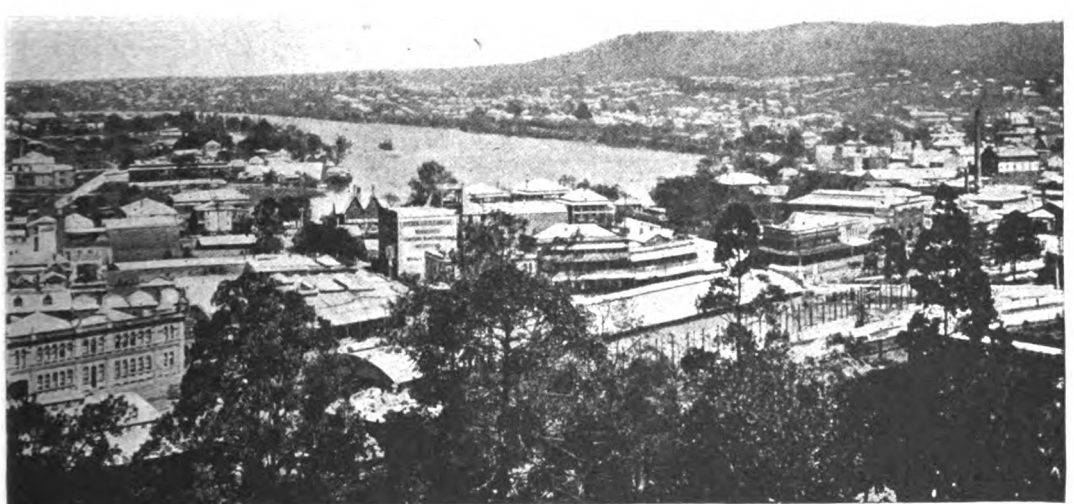


Photo by permission of the Agent-General for Queensland.

BRISBANE: THE CAPITAL OF QUEENSLAND,

an important commercial centre, largely interested in the export of frozen meat, tallow and hides.

Continued from page 112.

MATHEMATICS:

Contributor: — ARITHMETIC, ALGEBRA, GEOMETRY, CO-ORDINATE GEOMETRY, TRIGONOMETRY, MECHANICS, MENSURATION, ETC.

(M. A. Lewenz, M.A.[Lond.]).

ALGEBRA.—XXVI

150. We will now extend Theorem II § 148 as far as possible to the case where one of the series does not have all its terms of the same sign.

(i) Let the U series have all its terms of the same sign and be convergent.

Let the V series *not* have all its terms of the same sign, but let it be such that $\frac{v_n}{u_n}$ is finite.

Then as before $\frac{v_n}{u_n}$ lies between two limiting values A and B which, however, may not be of the same sign.

As before we have

$A\,(u_1 + u_2 + u_3 + \ldots + u_n) < (v_1 + v_2 + \ldots + v_n) < B\,(u_1 + u_2 + \ldots + u_n)$ I

where A may be negative and B is positive.

Again we can deduce that

$A\,(u_{n+1} + u_{n+2} + \ldots + u_{n+r}) < (v_{n+1} + v_{n+2} + \ldots + v_{n+r}) < B\,(u_{n+1} + u_{n+2} + \ldots + u_{n+r})$ II

$\because$ U series is convergent $u_1 + u_2 + \ldots + u_n$ is finite, however large n may be. But $\because$ the signs of the terms of the V series are not all alike, we must determine whether the V series can oscillate or not.

$\because$ U series is convergent, we know that $u_{n+1} + u_{n+2} + \ldots + u_{n+r}$ diminishes without limit as n increases without limit

$\therefore$ by II above, we know where r is any integer that $v_{n+1} + v_{n+2} + \ldots v_{n+r}$ must diminish without limit as n increases without limit.

$\therefore$ V series satisfies the two conditions of convergency.

(ii) Let the U series have all the terms of the same sign and be divergent.

Let the V series *not* have all its terms of the same sign.

Then as before we get the statement I above.

But $u_1 + u_2 + \ldots + u_n$ increases without limit as n increases without limit

$\because$ $A\,(u_1 + u_2 + \ldots + u_n)$ approaches $-\infty$ $\because$ A is negative and B $(u_1 + u_2 + \ldots + u_n)$ approaches $+\infty$ $\because$ B is positive

$\therefore$ from I we can draw no conclusion as to whether $v_1 + v_2 + \ldots + v_n$ is finite or infinite.

Hence in this case the V series may be convergent or divergent.

Consider for example the series

$$U = 1 + \frac{1}{2} + \frac{1}{3} + \ldots + \frac{1}{n} + \ldots$$

$$V = 1 - \frac{1}{2} + \frac{1}{3} - \frac{1}{4} + \ldots + \frac{(-1)^{n-1}}{n} + \ldots$$

We know that the U series is divergent, and if we rewrite the V series thus: $\left(1 - \frac{1}{2}\right) + \left(\frac{1}{3} - \frac{1}{4}\right) + \ldots + \frac{(-1)^{n-1}}{n} + \ldots$ we see, provided the terms are not displaced that V has a positive sum. Moreover, if we rewrite the V series thus: $1 - \left(\frac{1}{2} - \frac{1}{3}\right) - \left(\frac{1}{4} - \frac{1}{5}\right) - \ldots\ldots$, it is clear that $V < 1$ and $\therefore$ V series is convergent.

151. When in a series the convergency ratio $\frac{T_{n+1}}{T_n}$ approaches 1 in such a way that its difference from 1 can be made less than any assignable quantity by taking n large enough, the series may be convergent or divergent.

There is an important case of this, viz. the series

$$S = \frac{1}{1^k} + \frac{1}{2^k} + \frac{1}{3^k} + \ldots + \frac{1}{n^k} + \ldots\ldots$$

$$\frac{T_{n+1}}{T_n} = \frac{n^k}{(n+1)^k} = \left(\frac{n}{n+1}\right)^k = \left(1 - \frac{1}{n+1}\right)^k$$

By making n large enough, this expression can be made to differ from unity by less than any assignable quantity.

Consider 1, 2, 2^2, 2^3. . . . . .

Rewrite S, grouping the terms so that the number of the term (1) beginning and (2) ending the group coincides with the above numbers. Thus

$$\text{I. } S = \frac{1}{1^k} + \left(\frac{1}{2^k} + \frac{1}{3^k}\right) + \left(\frac{1}{4^k} + \frac{1}{5^k} + \frac{1}{6^k} + \frac{1}{7^k}\right) + \left(\frac{1}{8^k} + \ldots\ldots\frac{1}{15^k}\right) + \ldots\ldots$$

$$\text{II. } S = \frac{1}{1^k} + \frac{1}{2^k} + \left(\frac{1}{3^k} + \frac{1}{4^k}\right) + \left(\frac{1}{5^k} + \frac{1}{6^k} + \frac{1}{7^k} + \frac{1}{8^k}\right) + \ldots\ldots$$

We assume that k is a positive quantity, for if k be negative, then $S = 1^{-k} + 2^{-k} + 3^{-k}$ . . . . . in which the terms increase from the beginning, and S is clearly divergent.

Consider I.:

$$S < \frac{1}{1^k} + \left(\frac{1}{2^k} + \frac{1}{2^k}\right) + \left(\frac{1}{4^k} + \frac{1}{4^k} + \frac{1}{4^k} + \frac{1}{4^k}\right) + \left(\frac{1}{8^k} + \ldots + \frac{1}{8^k}\right) + \ldots$$

$$\therefore S < \frac{1}{1^k} + \frac{2}{2^k} + \frac{4}{4^k} + \frac{8}{8^k} + \ldots + \frac{2^r}{(2^r)^k} + \ldots \text{ A}$$

Again consider form II.

$$S > \frac{1}{1^k} + \frac{1}{2^k} + \left(\frac{1}{4^k} + \frac{1}{4^k}\right) + \left(\frac{1}{8^k} + \frac{1}{8^k} + \frac{1}{8^k} + \frac{1}{8^k}\right) + \ldots$$

$$> \frac{1}{1^k} + \frac{1}{2^k} + \frac{2}{4^k} + \frac{4}{8^k} + \ldots + \frac{2^r}{(2^{r+1})^k} + \ldots \text{ B}$$

Hence S lies between two series. One of them A is a G. P. from the start, the other B is a G. P. from the second term onwards; the common ratio of both is $\frac{2}{2^k}$. If $k < 1$ this common ratio > 1 and the G. P.s both have an infinite sum. If $k > 1$, the common ratio < 1 and the G. P.s both have a finite sum. If $k = 1$, the common ratio $= 1$ and the G. P.s both have an infinite sum. Thus when $k = 1$ or < 1, the series S is divergent, but if $k > 1$, S lies between two finite sums and is $\therefore$ convergent.

Thus series is convergent if $k > 1$
series is divergent if $k < 1$

152. A series in which all the terms have **not** the same sign is said to be **absolutely convergent** if it is convergent when all the terms are made positive.

If in a series in which some terms are positive and others negative, all the terms are made positive. Then supposing the series thus altered is convergent, the original series must be convergent, for the sum of the first n terms of the original series can never exceed the sum of the first n terms of the altered series $\therefore$ the sum of the first n terms of the original series is finite.

Again the sum of the next r terms of the original series cannot exceed the sum of the next r terms of the altered series. But the sum of these last can be made less than any assignable quantity however small $\therefore$ the altered series is convergent $\therefore$ the sum of the r terms following the first n terms in the original series can be made less than any assignable quantity however small.

$\therefore$ the original series is convergent.

(v) *A series is convergent when its terms are alternately positive and negative, if each term is less than the preceding one, and the terms decrease without limit in absolute*[1] *magnitude.*

Consider $S = u_1 - u_2 + u_3 - \ldots + (-1)^{r-1} u_r + (-1)^r u_{r+1} + \ldots$

Given that $u_p > u_{p+1}$

We rewrite S in two ways:

I $S = (u_1 - u_2) + (u_3 - u_4) + \ldots + (u_{2n-1} - u_{2n}) + \ldots$

II $S = u_1 - (u_2 - u_3) - (u_4 - u_5) \ldots (u_{2n} - u_{2n+1}) \ldots$

$\because u_p > u_{p+1}$ every bracket in I and II is positive.

From I we see that S is positive, from II we see that $S < u_1$. Hence $0 < S < u_1$.

$\therefore$ first condition of convergency is satisfied.

Consider all terms from the $(2n-1)$th onward.

Their sum $= (u_{2n-1} - u_{2n}) + (u_{2n+1} - u_{2n+2}) + \ldots$ I.

$= u_{2n-1} - (u_{2n} - u_{2n+1}) - (u_{2n+2} - u_{2n+3}) - \ldots$ II.

I shows that this sum is positive.

II shows that this sum $< u_{2n-1}$.

Now if by taking n sufficiently large we can make u_{2n-1} less than any assignable quantity however small, then the sum of all the terms after the (2_{n-2})th can be made less than any assignable quantity however small, and in that case the series is convergent.

Note that the series $\frac{2}{1} - \frac{3}{2} + \frac{4}{3} - \ldots + (-1)^{r-1}\frac{r+1}{r} + \ldots$ is not convergent although $T_{r+1} > T_{r1}$ for the second condition of convergency is not satisfied, for $\frac{r+1}{r}$ does not approach 0 as r increases without limit.

153. Convergency of the **Binomial Series.**

$$1 + nx + \frac{n(n-1)}{2!}x^2 + \ldots + \frac{n(n-1)\ldots(n-r+1)}{r!}x^r + \ldots .^1$$

$$\frac{T_{r+1}}{T_r} = \frac{n-r+1}{r}x = -\left(1 - \frac{n+1}{r}\right)x$$

If we take r large enough $\left(1 - \frac{n+1}{r}\right)$ can be made to differ from 1 by a difference smaller than any assignable quantity.

$\therefore$ the numerical value of the convergency ratio may be made to approach as close as we please to the numerical value of x.

T_{r+1} and T_r will have different signs when x is negative, and will have the same sign when x is positive. If $x < 1$ and if we take any quantity k differing from 1 by a finite difference and such that $|x| < k < 1$, we can always find a value of r such that from T_r onwards the convergency ratio $\frac{T_{r+1}}{T_r} < k$ and $\therefore$ the series is convergent.

If $(n+1)$ be positive and we take $r > (n+1)$ then $\left(1 - \frac{n+1}{r}\right)$ is a positive proper fraction and consequently we may take $k = |x|$ provided we take r the integer next greater than $(n+1)$.

[1] By the absolute magnitude of x we mean its magnitude irrespective of sign, and we denote it by $|x|$.

[1] If n is a positive integer, the series is finite: but if n is fractional or negative, the series is infinite.

If $(n+1)$ be negative then $\left(1-\frac{n+1}{r}\right)$ is always > 1.

To find what value of r we must take in this case.

We have $|x| < k < 1$.

Then we must have $\left(1-\frac{n+1}{r}\right) . |x| < k$

i.e. $1-\frac{n+1}{r} < \frac{k}{|x|}$; i.e. $-\frac{n+1}{r} < \frac{K-|x|}{|x|}$;

i.e. $\frac{-(n+1) . |x|}{k-|x|} < r$

Now $-(n+1)$ is positive $\therefore$ this enables us to find r

Hence the series is convergent if $|x| < 1$.

If $|x| > 1$ the terms ultimately increase and the series is divergent.

If $x = 1$, $\frac{T_{r+1}}{T_r}$ approaches the value 1 and nothing has been decided by the above test.

154. Convergency of the **Exponential Series**

$$1 + x + \frac{x^2}{2!} + \frac{x^3}{3!} + \ldots + \frac{x^n}{n!} + \ldots .$$

If x be negative, the terms have alternate signs, and the series will be convergent if we can prove that it is convergent when x is positive and $\therefore$ all the terms are positive.

Suppose x positive.

$\frac{T_{n+1}}{T_n} = \frac{x}{n}$. If $\therefore$ we take n the integer next greater than x, the convergency ratio for all terms following T_n will be < 1 by a finite difference k.

To find the value of k.

$$\left.\begin{aligned} \frac{T_{n+2}}{T_{n+1}} &= \frac{x}{n+1} < \frac{x}{n} \\ &\ldots\ldots \\ \frac{T_{n+r+1}}{T_{n+r}} &= \frac{x}{n+r} < \frac{x}{n} \end{aligned}\right\} \therefore \text{ we may take } k = \frac{x}{n}$$

As n is the integer next greater than x, $k < 1$ by a finite difference.

$\therefore$ the series is convergent for all values of x.

155. Convergency of the **Logarithmic Series.**

$$\log. e(1+x) = x - \frac{x^2}{2} + \frac{x^3}{3} - \ldots . - (-1)^n \frac{x^n}{n} + \ldots .$$

$$\frac{T_{n+1}}{T_n} = -x\left(\frac{n}{n+1}\right) = -x\left(1-\frac{1}{n+1}\right)$$

As n increases without limit, the convergency ratio increases and approaches more and more closely to the numerical value of x

$\therefore$ if $x > 1$, the series is divergent.

If $x < 1$ we can take $k = |x|$, and take n so that for all terms following T_n, the convergency ratio $< k < 1$, i.e. $\frac{T_{n+1}}{T_n} < |x| < 1$

and $\therefore$ the series is convergent.

If $x = +1$, the series $= 1 - \frac{1}{2} + \frac{1}{3} - \frac{1}{4} + \ldots . + \frac{1}{2n+1} - \frac{1}{2n+2} + \ldots$ and this is convergent by Theorem V.

If $x = -1$, the series $= -\left(1 + \frac{1}{2} + \frac{1}{3} + \frac{1}{4} + \ldots + \frac{1}{n} + \right)$ and this we know is divergent.

156. If 2 series

$U = u_0 + u_1 x + u_2 x^2 + \ldots . + u_n x^n + \ldots$

$V = v_0 + v_1 x + v_2 x^2 + \ldots . + v_n x^n + \ldots ..$

be both convergent, and a 3rd series be formed in which the coefficient of any power of x is the same as the coefficient of that power of x in the product U $\times$ V, namely

$P = u_0 v_0 + x(u_0 v_1 + u_1 v_0) + x^2(u_0 v_2 + u_1 v_1 + u_2 v_0) + \ldots ..$

$\ldots + x^n (u_0 v_n + u_1 v_{n-1} + \ldots . + u_r v_{n-r} + \ldots + u_n v_0) + \ldots$

Then P will be a convergent series $=$ U $\times$ V, provided (1) that U and V have all their terms positive or (2) that U and V would not lose their convergency if all the terms were made positive.

Let $U_n = u_0 + u_1 x + u_2 x^2 + \ldots .. + u_{n-1} x^{n-1}$ (i)

$V_n = v^0 + v_1 x + v_2 x^2 + \ldots .. + v_{n-1} x^{n-1}$ (ii)

P_n = first n terms of the P series.

$U_{2n} \times V_{2n} = P_{2n}$ + terms containing x^{2n} and higher powers of x.

$\therefore U_{2n} \times V_{2n} > P_{2n}$ ($\therefore$ all terms are assumed positive)

Also $P_{2n} = U_n \times V_n$ + positive terms.

$\therefore P_{2n} > U_n \times V_n$

$\therefore U_{2n} \times V_{2n} > P_{2n} > U_n \times V_n$

$\because$ U and V series are convergent $\therefore U_n \times V_n$ approaches a finite limit U $\times$ V and also $U_{2n} \times V_{2n}$ approaches a finite limit U $\times$ V

$\therefore P_{2n}$, which lies between them, approaches the same finite limit U $\times$ V.

Now $P_{2n} = u_0 v_0 + x(u_0 v_1 + u_1 v_0) + \ldots . + x^{2n-1}(u_0 v_{2n-1} + \ldots . + u_{2n-1} v_0)$ (iii)

Also $U_{2n} = u_0 + u_1 x + \ldots .. + u_{2n-1} x^{2n-1}$ (iv)

and $V_{2n} = v_0 + v_1 x + \ldots .. + v_{2n-1} x^{2n-1}$ (v)

From (iii), (iv) and (v) we have

$U_{2n} V_{2n} - P_{2n} = u_0 v_0 + x(u_0 v_1 + u_1 v_0) + \ldots + x^{2n-1}(u_0 v_{2n-1} + \ldots + u_{2n-1} v_0) + x^{2n}(u_1 v_{2n-1} + \ldots .. + u_{2n-1} v_1) + x^{2n+1}(u_2 v_{2n-1} + \ldots . + u_{2n-1} v_2) + \ldots + x^{4n-3}(u_{2n-2} v_{2n-1} + u_{2n-1} v_{2n-2}) + x^{4n-2} u_{2n-1} v_{2n-1} - P_{2n} = x^{2n}(u_1 v_{2n-1} + \ldots + u_{2n-1} v_1) + x^{2n+1}(u_2 v_{2n-1} + \ldots . + u_{2n-1} v_2) + \ldots .. + x^{4n-3}(u_{2n-2} v_{2n-1} + u_{2n-1} v_{2n-2}) + x^{4n-2} u_{2n-1} v_{2n-1}$.

Now every term in the original series is positive

$\therefore U_{2n} V_{2n} - P_{2n}$ is positive.

Similarly we may show that

$P_{2n} - U_n V_n = x^n (u_0 v_n + u_n v_0) + x^{n+1} (u_0 v_{n+1} + u_1 v_n + u_n v_1 + u_{n+1} v_0) + \ldots$
$+ x^{2n-3} (u_0 v_{2n-3} + \ldots + u_{n-3} v_n + u_n v_{n-3} + \ldots + u_{2n-3} v_0) + x^{2n-2} (u_0 v_{2n-2} + \ldots$
$+ u_{n-2} v_n + u_n v_{n-2} + \ldots + u_{2n-2} v_0)$
$+ x^{2n-1} (u_0 v_{2n-1} + \ldots + u_{2n-1} v_0)$

$\therefore P_{2n} - U_n V_n > 0.$

$\therefore U_{2n} V_{2n} > P_{2n} > U_n V_n$

Now the U and V series are both convergent, and when n increases without limit the products $U_{2n} V_{2n}$ and $U_n V_n$ both approach the same limit U V.

And $\therefore P_{2n}$ always lies between $U_{2n} V_{2n}$ and $U_n V_n$.

$\therefore P_{2n}$ also approaches the same limit U V when n becomes infinitely great.

$\therefore$ P is a convergent series and approaches the value of the product of the quantities towards which the other two series converge.

When the series do not have their terms all of the same sign, but are such that they remain convergent when all the terms are made positive, we take the same symbols for the series as before, except that we accent the letters u v and x thus: u', v', x'.

Replace every letter u', v', x' by a quantity having the same magnitude but being positive, so that x = positive value of x' and v_n = positive value of v'_n.

Then by hypothesis the new series are still convergent.

$\therefore$ again we have $U_{2n} V_{2n} - P_{2n}$ and also $P_{2n} - U_n V_n$ positive.

Further $U_{2n} V_{2n} - P_{2n}$ for the original series cannot exceed $U_{2n} V_{2n} - P_{2n}$ for the altered series; for the value of these quantities in the original series may be less than their value for the altered series owing to the presence of negative terms, but cannot be greater.

Now in the altered series we know that as n increases without limit $U_{2n} V_{2n}$, $U_n V_n$ and P_{2n} all approach the same limit U V.

$\therefore$ as n increases without limit $U_{2n} V_{2n} - P_{2n}$ and $P_{2n} - U_n V_n$ both approach 0.

$\therefore$ we know that the corresponding quantities for the original series approach 0 when n increases without limit.

But in the original series U_n approaches the value U $\because$ U is convergent,

and V_n approaches the value V $\because$ V is convergent.

$\therefore P_{2n}$ approaches the value U V.

$\therefore$ P series is convergent, and its value is the product U V. M. A. L.

TRIGONOMETRY.—I

1. THE object of Plane Trigonometry is to enable us to solve plane triangles. Such triangles have three sides and three angles, and by the aid of Plane Trigonometry, if the magnitudes of any three of these six elements are given, we can calculate the magnitudes of the other three.

2. A **unit** is a standard quantity or magnitude, by which other magnitudes may be measured.

We may conveniently take a right angle as the unit by which we measure angles. A right angle is divided into 90 equal parts called degrees (90°); a degree is divided into 60 equal parts called minutes (60′); and a minute is divided into 60 equal parts called seconds (60″).

3. We assume that the student is familiar with the elementary geometrical truths. We also assume that he can find the square root of any number to any desired degree of accuracy.

4. Trigonometrical ratios of an acute angle.

Let P O M be any acute angle denoted by α. Take any point P in one of the bounding lines of α, and from P drop a perpendicular P M on to the other bounding line.

The following are called the trigonometrical ratios of the angle α:—

$\frac{\text{Base O M}}{\text{Hypotenuse O P}} = \frac{\text{O M}}{\text{O P}}$ is called the cosine of α and is written cos α.

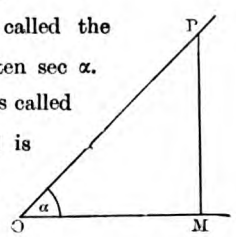
$\frac{\text{Perpendicular P M}}{\text{Hypotenuse O P}} = \frac{\text{P M}}{\text{O P}}$ is called the sine of α and is written sin α.

$\frac{\text{Perpendicular P M}}{\text{Base O M}} = \frac{\text{P M}}{\text{O M}}$ is called the tangent of α and is written tan α.

$\frac{\text{Hypotenuse O P}}{\text{Base O M}} = \frac{\text{O P}}{\text{O M}}$ is called the secant of α and is written sec α.

$\frac{\text{Hypotenuse O P}}{\text{Perpendicular P M}} = \frac{\text{O P}}{\text{P M}}$ is called the cosecant of α and is written cosec α.

$\frac{\text{Base O M}}{\text{Perpendicular P M}} = \frac{\text{O M}}{\text{P M}}$ is called the cotangent of α and is written cot α.

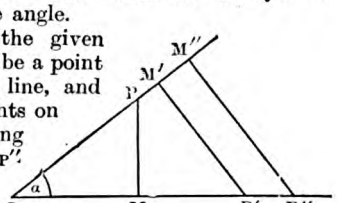


Powers of the trigonometrical ratios are written thus: $(\cos \alpha)^2$, $(\sin \alpha)^3$, and so on; but when the powers are positive and integral it is more usual to write them thus: $\cos^2 \alpha$, $\sin^3 \alpha$, $\tan^4 \alpha$.

Inverse Notation.—A similar method of notation is used to denote angles having a given sine, cosine, etc. Thus $\sin^{-1}\frac{1}{2}$ stands for "the angle whose sine = $\frac{1}{2}$," and $\tan^{-1}5$ stands for "the angle whose tangent is 5."

5. The trigonometrical ratios of an angle depend on the angle only. In other words, the trigonometrical ratios are always the same for the same angle.

Let P O M be the given angle α, and let P be a point on one bounding line, and P′, P″ be two points on the other bounding line. From P, P′, P″ drop perpendiculars P M, P′ M′, P″ M″ on the other bounding line of α.



Then the three triangles P O M, P′ O M′, P″ O M″ each contain a right angle, and the angle α is common to them all, $\therefore$ their remaining angles must be equal to one other.

$\therefore$ the $\triangle$s P O M, P′ O M′, P″ O M″ are similar,

$$\therefore \frac{O M}{O P} = \frac{O M'}{O P'} = \frac{O M''}{O P''}$$

i.e. the cosine of the angle α is the same wherever the point P be taken,

i.e. the cosine of an angle depends on the angle only.

Similarly it may be shown that the other trigonometrical ratios depend on the angle only.

6. The cosine and secant of an angle are reciprocal, likewise the sine and cosecant, and the tangent and cotangent.

Consider the figure in § 4.

$$\text{Cos } \alpha \cdot \sec \alpha = \frac{O M}{O P} \cdot \frac{O P}{O M} = 1$$

$$\therefore \cos \alpha = \frac{1}{\sec \alpha}$$

$$\text{Again, } \sin \alpha \cdot \operatorname{cosec} \alpha = \frac{P M}{O P} \cdot \frac{O P}{M P} = 1$$

$$\therefore \sin \alpha = \frac{1}{\operatorname{cosec} \alpha}$$

$$\text{And } \tan \alpha \cdot \cot \alpha = \frac{P M}{O M} \cdot \frac{O M}{O P} = 1$$

$$\therefore \tan \alpha = \frac{1}{\cot \alpha}$$ } A

7. The cosine of an angle equals the sine of its complement, the tangent of an angle equals the cotangent of its complement, and the cosecant of an angle equals the secant of its complement.

NOTE.—If the sum of two angles is 90°, the one angle is called the complement of the other.

Consider the figure in § 4.

$$\cos \alpha = \frac{O M}{O P} = \sin \text{ O P M} = \sin (90° - \alpha)$$

$$\sin \alpha = \frac{P M}{O P} = \cos \text{ O P M} = \cos (90° - \alpha)$$

$$\tan \alpha = \frac{P M}{O M} = \cot \text{ O P M} = \cot (90° - \alpha)$$

$$\cot \alpha = \frac{O M}{P M} = \tan \text{ O P M} = \tan (90° - \alpha)$$

$$\sec \alpha = \frac{O P}{O M} = \operatorname{cosec} \text{ O P M} = \operatorname{cosec} (90° - \alpha)$$

$$\operatorname{cosec} \alpha = \frac{O P}{P M} = \sec \text{ O P M} = \sec (90° - \alpha)$$ } B

8. To prove that $\tan \alpha = \frac{\sin \alpha}{\cos \alpha}$ and $\cot \alpha = \frac{\cos \alpha}{\sin \alpha}$.

Consider the figure in § 4.

$$\frac{\sin \alpha}{\cos \alpha} = \frac{P M}{O P} \div \frac{O M}{O P} = \frac{P M}{O P} \times \frac{O P}{O M} = \frac{P M}{O M} = \tan \alpha$$

$$\frac{\cos \alpha}{\sin \alpha} = \frac{O M}{O P} \div \frac{P M}{O P} = \frac{O M}{P M} = \cot \alpha$$ } C

9. To prove that $\cos^2 \alpha + \sin^2 \alpha = 1$,

$$1 + \tan^2 \alpha = \sec^2 \alpha$$

and $$\cot^2 \alpha + 1 = \operatorname{cosec}^2 \alpha$$

Consider the figure in § 4.

$\because$ O M P is a rt. $\angle$ $\therefore$ $O M^2 + P M^2 = O P^2$ (1)

Dividing by $O P^2$ we have $\frac{O M^2}{O P^2} + \frac{P M^2}{O P^2} = \frac{O P^2}{O P^2}$

i.e. $\cos^2 \alpha + \sin^2 \alpha = 1$ . . . D

Dividing both sides of equation (1) by $O M^2$ we have

$$\frac{O M^2}{O M^2} + \frac{P M^2}{O M^2} = \frac{O P^2}{O M^2}$$

i.e. $1 + \tan^2 \alpha = \sec^2 \alpha$ . . . E

Again, dividing both sides of equation (1) by $P M^2$ we have

$$\frac{O M^2}{P M^2} + \frac{P M^2}{P M^2} = \frac{O P^2}{P M^2}$$

i.e. $\cot^2 \alpha + 1 = \operatorname{cosec}^2 \alpha$ . . F

Having given the cosine of an angle, to express the other trigonometrical ratios of that angle in terms of the cosine.

(*a*) *Analytical method.*

$$\cos^2 \alpha + \sin^2 \alpha = 1 \quad \therefore \sin^2 \alpha = (1 - \cos^2 \alpha)$$

$$\therefore \sin \alpha = \sqrt{1 - \cos^2 \alpha}$$

$$\tan^2 \alpha = \frac{\sin^2 \alpha}{\cos^2 \alpha} = \frac{1 - \cos^2 \alpha}{\cos^2 \alpha}$$

$$\therefore \tan \alpha = \frac{\sqrt{1 - \cos^2 \alpha}}{\cos \alpha}$$

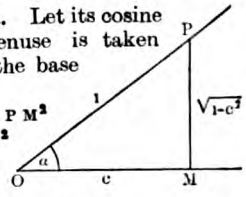
$$\sec \alpha = \frac{1}{\cos \alpha}$$

$$\operatorname{cosec} \alpha = \frac{1}{\sin \alpha} = \frac{1}{\sqrt{1 - \cos^2 \alpha}}$$

$$\cot \alpha = \frac{1}{\tan \alpha} = \frac{\cos \alpha}{\sqrt{1 - \cos^2 \alpha}}$$ } G

(*b*) *Geometrical method.*

Let P O M be the angle α. Let its cosine = c. Then if the hypotenuse is taken as the unit of length 1, the base O M must = c.



And since $O P^2 = O M^2 + P M^2$

$\therefore$ $P M^2 = O P^2 - O M^2$

$\therefore$ $P M = \sqrt{1 - c^2}$

$$\therefore \sin \alpha = \frac{\sqrt{1 - c^2}}{1} = \sqrt{1 - \cos^2 \alpha}$$

$$\tan \alpha = \frac{\sqrt{1 - c^2}}{c} = \frac{\sqrt{1 - \cos^2 \alpha}}{\cos \alpha}$$

$$\sec \alpha = \frac{1}{c} = \frac{1}{\cos \alpha}$$

$$\operatorname{cosec} \alpha = \frac{1}{\sqrt{1 - c^2}} = \frac{1}{\sqrt{1 - \cos^2 \alpha}}$$

$$\cot \alpha = \frac{c}{\sqrt{1 - c^2}} = \frac{\cos \alpha}{\sqrt{1 - \cos^2 \alpha}}$$

10. Having given the tangent of an angle, to express the other trigonometrical ratios of the angle in terms of the tangent.

(*a*) *Algebraic method.*

$$\sec^2 \alpha = 1 + \tan^2 \alpha$$

$$\therefore \sec \alpha = \sqrt{1 + \tan^2 \alpha}$$

$$\cos \alpha = \frac{1}{\sec \alpha} = \frac{1}{\sqrt{1 + \tan^2 \alpha}}$$

$\because \frac{\sin \alpha}{\cos \alpha} = \tan \alpha$ $\therefore \sin \alpha = \cos \alpha \cdot \tan \alpha$

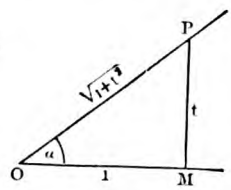
$$= \frac{\tan \alpha}{\sqrt{1 + \tan^2 \alpha}}$$

$$\operatorname{cosec} \alpha = \frac{1}{\sin \alpha} = \frac{\sqrt{1 + \tan^2 \alpha}}{\tan \alpha}$$

$$\cot \alpha = \frac{1}{\tan \alpha}$$ } H

(*b*) *Geometrical method.*

Let P O M be the angle α. Then if $\tan\alpha = t$, taking the base O M as the unit of length 1, P M must $= t$ and, $\because$ O P^2 = O M^2 + P M^2 $\therefore$ Q P = $\sqrt{1+t^2}$.



$$\sin\alpha = \frac{PM}{OP} = \frac{t}{\sqrt{1+t^2}} = \frac{\tan\alpha}{\sqrt{1+\tan^2\alpha}}$$

$$\cos\alpha = \frac{OM}{OP} = \frac{1}{\sqrt{1+t^2}} = \frac{1}{\sqrt{1+\tan^2\alpha}}$$

$$\operatorname{cosec}\alpha = \frac{OP}{PM} = \frac{\sqrt{1+t^2}}{t} = \frac{\sqrt{1+\tan^2\alpha}}{\tan\alpha}$$

$$\sec\alpha = \frac{OP}{OM} = \frac{\sqrt{1+t^2}}{1} = \sqrt{1+\tan^2\alpha}$$

$$\cot\alpha = \frac{OM}{PM} = \frac{1}{t} = \frac{1}{\tan\alpha}$$

11. The trigonometrical ratios of certain acute angles.

Let A B C be an equilateral $\triangle$. Draw C D $\perp^r$ to A B. Then C D bisects $\angle$ A C B and also the base A B.

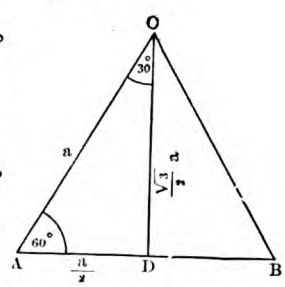
$$\angle CAD = 60^\circ \text{ and } \angle ACD = \angle 30^\circ$$

If the length of A C $= a$, then A D $= \frac{a}{2}$

and C D $= \sqrt{AC^2 - AD^2} = \sqrt{a^2 - \frac{a^2}{4}} = \sqrt{\frac{3a^2}{4}}$

$$= \frac{\sqrt{3}}{2}a$$

Then



$$\cos 60^\circ = \sin 30^\circ = \frac{AD}{AC} = \frac{\frac{a}{2}}{a} = \frac{1}{2}$$

$$\sin 60^\circ = \cos 30^\circ = \frac{CD}{AC} = \frac{\frac{\sqrt{3}}{2}a}{a} = \frac{\sqrt{3}}{2}$$

$$\tan 60^\circ = \cot 30^\circ = \frac{CD}{AD} = \frac{\frac{\sqrt{3}}{2}a}{\frac{a}{2}} = \sqrt{3}$$

$$\sec 60^\circ = \operatorname{cosec} 30^\circ = \frac{AC}{AD} = \frac{a}{\frac{a}{2}} = 2$$

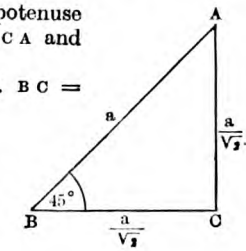
$$\operatorname{cosec} 60^\circ = \sec 30^\circ = \frac{AC}{CD} = \frac{a}{\frac{\sqrt{3}}{2}a} = \frac{2}{\sqrt{3}}$$

$$\cot 60^\circ = \tan 30^\circ = \frac{AD}{CD} = \frac{\frac{a}{2}}{\frac{\sqrt{3}}{2}a} = \frac{1}{\sqrt{3}}$$

Let A B C be an isosceles $\triangle$ having the $\angle$ C a rt. angle. Then each of the angles A and B will equal 45°.

If the length of the hypotenuse A B $= a$, then $\because$ B C $=$ C A and B C^2 + C A^2 = A B^2

$\therefore$ 2 B C^2 $= a^2$ $\therefore$ B C $= \frac{a}{\sqrt{2}}$ = C A



$\therefore$ cos 45° = sin 45°

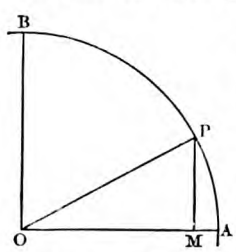
$$= \frac{BC}{AB} = \frac{\frac{a}{\sqrt{2}}}{a} = \frac{1}{\sqrt{2}}$$

$$\tan 45^\circ = \cot 45^\circ = \frac{AC}{BC} = \frac{\frac{a}{\sqrt{2}}}{\frac{a}{\sqrt{2}}} = 1$$

$$\sec 45^\circ = \operatorname{cosec} 45^\circ = \frac{AB}{BC} = \frac{a}{\frac{a}{\sqrt{2}}} = \sqrt{2}$$

12. Suppose we have a quantity x which is a function of a quantity y, so that as y changes x changes too.

If by making y approach more and more nearly a given value, say b, we can make x differ by as small a quantity as we please from a value a, then a is called the *limit* of x for the value $y = b$.



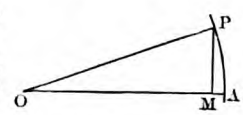
Let A P B be a circular arc of which the radii O A and O B are $\perp^r$ to one another. Let O P be any other radius, and let P M be drawn $\perp^r$ to O A. Then clearly the lengths of O M and P M will depend upon the size of the $\angle$ A O P. As $\angle$ A O P increases, P M increases and O M diminishes, and as $\angle$ A O P decreases, P M diminishes and O M increases.

If P moves clockwise to the position A, then in the limit, when P reaches A, $\angle$ A O P will equal 0°, P M will vanish, and O M will equal O A.

Similarly if P move counterclockwise to the position B, then $\angle$ A O P will equal 90°, P M will equal O B, and O M will vanish.

Hence we see that when the $\angle$ A O P approaches the value zero, the limit of P M is zero and the limit of O M is O A.

And when the $\angle$ A O P approaches the value 90° (i.e. become a rt. $\angle$) the limit of P M is B O and the limit of O M is zero.



Let A O P be a very small angle and A P a circular arc with centre O. Draw P M $\perp^r$ to O A.

$$\text{Cos AOP} = \frac{OM}{OP} \qquad \text{Sin AOP} = \frac{PM}{OP}$$

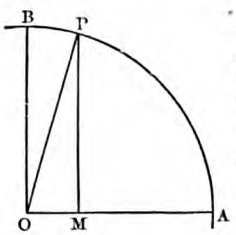
But we have shown that when $\angle$ A O P vanishes the limit of O M is O A and the limit of P M is O.

$\therefore$ when A O P vanishes, $\cos A O P = \frac{O A}{O P} = 1$ ($\because$ O A = O P); and $\sin A O P = \frac{0}{O P} = 0$.

Hence we see that $\cos 0° = 1$ and $\sin 0° = 0$.

Similarly $\tan 0° = 0$ and $\sec 0° = 1$

$\text{Cosec } 0° = \frac{O P}{0} = \infty$, and $\cot 0° = \infty$



Again, let A O P be an angle nearly = 90°. Let A P B be a circular arc having the radii O A and O B $\perp^r$ to each other, and draw P M $\perp$ to O A.

$\text{Cos } A O P = \frac{O M}{O P}$, $\sin A O P = \frac{P M}{O P}$.

We have shown that when $\angle$ A O P approaches the value 90°, the limit of O M is zero and the limit of P M is B O.

$\therefore$ when A O P is a rt. $\angle$, $\cos A O P = \frac{0}{O P} = 0$,

and $\sin A O P = \frac{B O}{O P} = 1$ ($\because$ B O = O P)

Hence we see that $\cos 90° = 0$, $\sin 90° = 1$.

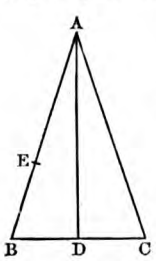
Similarly $\tan 90° = \infty$, $\sec 90° = \infty$

$\text{Cosec } 90° = 1$, $\cot 90° = 0$

Example.—Prove that $\text{cosec } 60° \cot 30° = \sec^2 45°$.

$\text{Cosec } 60° \cot 30° = \frac{2}{\sqrt{3}} \times \sqrt{3} = 2 = (\sqrt{2})^2 = (\sec 45°)^2 = \sec^2 45°$

The formulæ marked A to H and the values of the trigonometrical ratios of the angles 0°, 30°, 45°, 60°, 90° should be learnt by heart.



13. *To find the sine of* 18°.

Let A B C be an isosceles triangle constructed so that each of the equal angles B and C are double of the angle A (*see* course on Geometry).

Draw A D bisecting B C at D and consequently bisecting the angle A.

If m = number of degrees in A, then number of degrees in B = $2m$ = number of degrees in C.

$\therefore\ m + 2m + 2m = 180°\ \therefore\ m = \frac{180°}{5} = 36°$

$\therefore\ \angle$ B A D = 18°.

Let E be a point in A B, such that rect A B, B E = square on A E. Then A E = B C (*see* course on Geometry).

Let A B = a and A E = x then B C = x and $\therefore$ B D = $\frac{x}{2}$.

Also B E = $a - x$.

Now rectangle A B, B E = square on AE

i.e. $a(a - x) = x^2$

$\therefore\ x^2 + ax - a^2 = 0$

$\therefore\ x = \frac{-a \pm \sqrt{a^2 + 4a}}{2} = \frac{-a + a\sqrt{5}}{2}$.

If we take the negative sign before the root $x = -a\frac{(1 + \sqrt{5})}{2}$, a quantity numerically greater than a, and this of course is impossible since x is less than a

$\therefore$ we must take the positive sign before the root,

i.e. $x = \frac{(\sqrt{5} - 1)a}{2}$

$\sin 18° = \sin B A D = \frac{B D}{B A} = \frac{\frac{(\sqrt{5} - 1)a}{4}}{a} = \frac{\sqrt{5} - 1}{4}$

Exercise 1

Prove the following identities:

(1) $\sin^2 \alpha = \frac{\tan^2 \alpha}{1 + \tan^2 \alpha}$

(2) $\cos^2 \alpha \tan^2 \alpha + \sin^2 \alpha \cot^2 \alpha = 1$

(3) $\frac{\cos \alpha + \cos \beta}{\sin \alpha - \sin \beta} + \frac{\sin \alpha + \sin \beta}{\cos \alpha - \cos \beta} = 0$

(4) $\frac{\tan \theta + \tan \phi}{\cot \theta + \cot \phi} = \tan \theta \tan \phi$

(5) $(\sin^6 \alpha - \cos^6 \alpha) = (2 \sin^2 \alpha - 1)(1 - \sin^2 \alpha + \sin^4 \alpha)$

(6) $(\tan^2 \alpha + \tan^2 \beta) \cos^2 \alpha \cos^2 \beta = \cos^2 \alpha + \cos^2 \beta - 2 \cos^2 \alpha \cos^2 \beta$

(7) If $\sin \theta = \frac{3}{5}$, find $\tan \theta$, $\text{cosec } \theta$, $\cos \theta$

(8) If $\tan \phi = \frac{a}{b}$, find $\sin \phi$ and $\cos \phi$

(9) If $\sin \theta = a$ and $\tan \theta = b$, prove that $(1 - a^2)(1 + b^2) = 1$

(10) If $\cos \phi = \frac{2n}{1 + n^2}$, find $\sin \phi$ and $\tan \phi$

(11) Prove that $3 \sin 60° - 4 \sin^3 60° = 4 \cos 30° - 3 \cos 30°$

(12) Prove that $\sin 90° \cot 30° - \cot 45° \tan 60° = \text{cosec}^2 45° - 8 \sin^2 30°$

Find the value of:—

(13) $(2 \sin 90° \cos 30° \tan 45° + \cos 30° \sin^2 45° \tan 60° - \sec 60° \cos^2 45°)^2$

(14) $\sin^{-1} 0 + 2 \cos^{-1} \frac{\sqrt{3}}{2} + 4 \text{ cosec}^{-1} \frac{2}{\sqrt{3}} - 2 \sec^{-1} 2$

(15) $\text{cosec}^{-1} \sqrt{2} + 3 \sin^{-1} \frac{\sqrt{3}}{2} + 5 \tan^{-1} \frac{1}{\sqrt{3}}$

M. A. L.

Continued from page 115.

ART AND MUSIC:

***Contributors*:—THE THEORY OF ART (Hon. John Collier; J. G. B. Lynch). DRAWING AND PAINTING (J. G. B. Lynch). THE THEORY OF MUSIC (R. R. Terry, Mus.Doc., F.R.C.O.; Hubert Grant).**

MUSIC.—VII

LEGEND gives music an ancient home in the British Isles. It is even possible by Bardic remains to associate the name of Britain with Prydain, and the bards of King Brutus, whose date is placed about 1150 B.C. Some musical history has no surer foundation than have these legends. But we are able to glean a few facts from early records. A Roman traveller in Britain, after the legions of that Empire had been withdrawn, states that the harp and an instrument played with the bow were in use in Britain.

Records are very scanty, however, till we get into a settled period well beyond the Norman Conquest. One illustrious Saxon, St. Aldhelm (about 700), has the honour of being the first English writer that is known to have alluded to Neumes. Irish historians claim Aldhelm as a pupil of St. Mailduff, the traditional Irish founder of Mailduffsburg, or Malmesbury, to which abbey St. Dunstan presented an organ.

Early History

From the 12th century onwards we are on good ground. The music of the day was well established, and there are authors like Walter Odyngton, a monk of Evesham; Simon Tunsted, an East Anglian monk; and John, of Dunstable, etc., as authorities for our knowledge of the condition of the art of their period.

In connection with the earliest writings on music in Europe, as apart from the British Isles, it is customary to refer to a treatise composed somewhere in the century A.D. 840—940, and attributed to one of two authors—to a monk whose name has come down to posterity as Hucbald, or Hucbaldus, of St. Armand, Belgium; or to Odo, Abbot of Tomieres. This MS., or collection of MSS., long presented great difficulties to a number of translators.

A very notable French musical amateur, M. Charles Henri de Coussemaker (died 1876), who for fifty years pursued his studies into musical history of ancient collections of manuscripts, drew modern attention to Hucbald and to a number of English authors. François Fétis, with his "General History of Music," and François Auguste Gevaërt, who succeeded Fétis as director of the Brussels Conservatory, both did splendid work. Gevaërt died in 1908. Dr. Charles Burney and Sir John Hawkins, who graced the 18th century in England, are the best and most notable of our musical historians.

Celtic Art

Facts have come to light which may be accepted as proving the claim that Ireland did much to help forward the musical art both on the Continent and in England. Enthusiastic Irish scholars claim that an established system of music existed in Ireland even in pre-Christian times, and that in the early centuries of the Christian era Irish harpists and Irish teachers from monkish schools were regarded as educational authorities in France and Italy. They were, we are told, equally proficient in the ecclesiastical musical knowledge of the period, as in the special practice of the Irish art.

The riddle of the Oghams—curious inscriptions on stones and personal ornaments found in various places in Ireland, which date from the 3rd century A.D.—finds a solution, it is claimed, in that the Irish had a musical scale even at that remote period. It included a "tablature" or system of writing music in a sort of alphabetic notation to show the position of notes in relation to each other on the strings of the harp or lute.

Traditional national melodies, history, and general literature, go to show pretty conclusively that the Irish musical scale of the period of the Oghams, and inferentially

long antecedent to that, was *pentatonic* (Gr. *pente*, five); that is, it consisted of five sounds, which are sufficiently well represented in modern music by the black notes of the piano, as they are struck consecutively from G♭. A similar succession of intervals will be produced by striking the white notes F, G, A—C, D, as you can discover for yourself.

This is really a charming little succession of sounds, and lends itself very readily to the making of pretty tunes of either gay or plaintive nature. Start on any note you like for a key-note, and jump from one black key to any other, and you cannot fail to make a little tune that will be pleasant to the ear. The Irish used each note of the five as a key-note.

Ogham Inscriptions

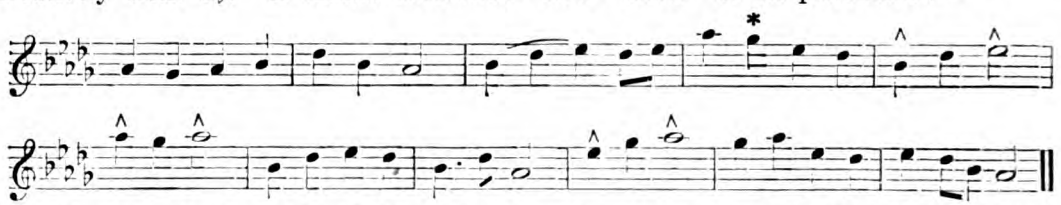
Now, the Ogham "inscriptions" consist of a horizontal line, with a number of upright (vertical) strokes either resting on or dependent from the horizontal line. The vertical strokes are of different lengths, and appear in groups, some of the strokes having a dot in front of them like the vowel sounds in Pitman's shorthand.

Let us presume, as certain of the Ogham solvers profess, that the horizontal line represented the middle note of the five (say, what we call G♭), then upright strokes of different lengths could stand for the two notes above the line, and other strokes depending from the horizontal line would mean the other two notes of the five.

Irishmen of authority claim the lute, or a kind of lute, as an instrument familiar in that country 1000 B.C. The notes of the lute (which was used for accompanying the voice) were the same as the pentatonic scale notes; but they were arranged in a different order, which would facilitate the playing of chords.

In regard to the pentatonic succession of intervals in their common order, a fact will have been noted—namely, that it would be impossible to have a stringed instrument tuned to such a scale without the player producing chords similar to those produced in modern harmony.

Ireland was by no means alone in its use of the pentatonic scale. It was, and is, in use to this day in the farthest ends of the earth. Here is the melody of the Japanese National Anthem in its present-day form in a "mode" of the pentatonic:—



In some versions, the air (at *) is modernised to suit the necessities of our harmonic system. But it is really in the second "mode" of the pentatonic.

Quaint and charming as the "gapped" or pentatonic scale is, and much as modern music is indebted to it in pianoforte pieces—e.g., Chopin's "Étude" on the black keys—many songs (and in orchestral works less frequently) its possibilities were decidedly limited.

Eventually it gave way in Europe before the development of the originally austere system of Ecclesiastical Modes, based upon the intervals now represented by the white keys of the piano, but sounding them, be it understood, according to the mathematical intervals of the monochord scale.

Whilst Harmony continued to be only of the elementary form of fourths and fifths, the system or practice suited itself to certain of the modes; but a feeling for "tonality" or ending a tune or what we call the key-note, accompanied by its natural "harmonics," gradually asserted itself.

Harmonic Progression

The position of the semi-tones in the scale we now call C major offered facilities for harmonic progressions not possessed by other scales; and so this became the solid rock on which our glorious edifice was constructed. Developments after this consisted in cleverly devising means to enable the same system of harmony—so admirable vocally—to be applied to the music of instruments the pitch of whose notes was mechanically fixed. The story of this wonderful accomplishment has unfortunately to be pieced out by speculation.

We may ourselves indulge our imagination a little, and try to throw our mental vision back to the thrilling days of ancient Rome. How the melody and harmony of the kind which has been illustrated by Hucbald would fit with the emotional

From the picture by Frans Hals in the Rijks Museum, Amsterdam. Photo: W. A. Mansell.

THE MERRY ANDREW.

A seventeenth century descendant of the mediæval troubadour to whom music is indebted both for invention and for genius.

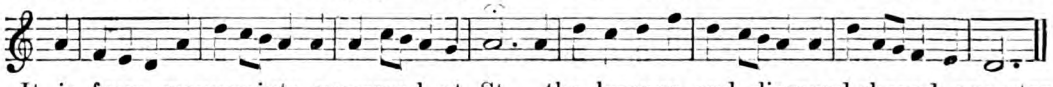
nature of those early Christians, gathering secretly in dread fear of torture and death, and pursuing their worship in subterranean catacombs!

It was these worshippers who appear to have preserved the traditions and style of the old religious music, and from the vaults of the dead it eventually ascended into the choirs and aisles of the cathedrals and churches, to become regularised at intervals under certain Popes.

St. Ambrose, Archbishop of Milan, also occupies a prominent niche amongst the hallowed figures of the past, for it is to him that we owe, amongst other things, the preservation in church use of the mode which commences on D (without sharps) and which is known as the Dorian Mode.

Tunes of the Dorian Mode

In this key some noble tunes, living and fresh to-day, have been written. It is a thrilling Sabbath evening experience to hear the following hymn tune, known as "Bangor," sung by a great congregation of university students and visitors at Aberystwyth, gathered in the shade of the big cliff at the north end of the bay, or by the vast assemblage in the bowl-shaped depression on the Great Orme at Llandudno (St. Tudno's Church), called the Happy Valley:—



It is from manuscripts preserved at St. Gall that we know something of the secular music of the day, and that it was of a much more inviting character than that which ecclesiastical and philosophic pedantry busied itself with.

When King Alfred took his harp and played and sang his way into the Danish camp, we may be sure his music was of an ingratiating character. But it was the philosophers who, after all, made present-day music possible, in the same way that an alphabet and a regularised system of representing spoken sounds made Literature possible.

Such music as we know of the early troubadours had melody, vivacity, and rhythm; but their musical means were limited, especially amongst those who confined themselves to the pentatonic scale, and it gradually died out so far as the Provençal type of minstrel was concerned.

The Minnesingers, too, of Southern Germany left little more than a memory behind them. The Meistersingers, who came later, the English minstrels portrayed on a pillar at Beverley Minster, and the French troubadours effigied at Bocherville, near Rouen, belong to an age when music was glimmering with something like its modern aspect.

But though some of these interesting groups have left their songs, or many of them, as a legacy, we do not know what their instrumental music was like. Possibly they practised together and got their harmony on their crude instruments by ear, like the Magyar "czardas" (or national dance) players, who were introduced to England nearly thirty years ago under the name of "Hungarian Bands." But these imported players, of course, did not "invent" their harmonies. They were only imitating, trying, perhaps, sometimes to improve on something heard before.

The mediæval troubadours were undoubtedly inventors, and some, like Adam de la Hale, were composers of genius. De la Hale, however, belonged to the 13th century, and henceforward things moved rapidly as the Middle Ages expired.

Let us see what, in a word, was happening. The ecclesiastics and philosophers of the ancient religious houses had made modern music possible.

The monk of Arezzo had set the world on the road to a universal sign-language for music.

The splendid idea of measured notes—the lozenge and diamond-shaped ancestors of our semibreves, minims, and crotchets—had been evolved by the writer, doubtfully identified as Franco of Cologne. The scale of C had been generally selected from the Church modes as the best suited to the expanding ideas of harmony.

Dawn of Modern Music

Semi-tones throughout the scale were in use, not only in vocal music but on instruments with keys; and many absurd notions and rules introduced by the pedantic were being broken down.

Experiments in counter-point—point against point—were being generally made by composers.

Fugue (Lat. *fuga*, a flight) was developing from ordinary counter-point.

Music was spreading her mighty pinions over Germany, Italy, France, and Britain. It was taking Form. The Sonata idea was in being. Secular music incorporated into the Church masses was preparing the way for Oratorio; and the first opera was not far distant.

H. G.

Continued from page 118.

BUSINESS AND COMMERCE:

Contributors:—BOOK-KEEPING (Frederick Heelis, F.C.I.S.). SHORTHAND (by arrangement with Pitman's Schools). COMMERCIAL TRAINING (Arthur Brooke). CHOOSING A CAREER (A. C. Marshall).

CHOOSING A CAREER.—XXVII

Medical Profession. — There are many reasons why there is an increasing demand for the services of doctors ; and the remuneration to be earned in this profession is far larger than it was.

The spread of municipal energies with the provision of medical officers, comparatively recent legislation such as the National Health Insurance Act and the various Workmen's Compensation Acts has brought a larger demand for doctors beyond those in strictly private practice ; and the number of hospitals and public institutions has become a growing factor in present-day conditions.

We must remember, however, that even if the demand has so greatly increased and the supply of doctors been lessened, it cannot be said that the road to the profession has been made in any way easier or shorter.

In the first place, the would-be doctor must remain at school until he is eighteen or nineteen years of age. He may then make a commencement in earnest by entering a University or Medical School ; and it may be said that at the very least five years must elapse before this period of training has passed.

It follows, therefore, that no young doctor can hope to be in the position of earning even a trifle towards his own support until he is twenty-five years of age ; and, even then, his earnings up to the age of thirty may be comparatively small.

It is no easy matter to approximate even broadly the cost of the training of a medical practitioner. When the student passes through one of the older Universities, the cost may well be put at a thousand pounds ; and certainly not less. London University, the Irish and Scottish Universities, and some of those in the provinces, offer a training at a lower cost ; but in no case can the total be stated as being less than £600.

For those students who attend at the Universities of Oxford and Cambridge the degree course includes at least a three years' residence. This is followed by two years at a Medical School in London before the final examination. Much the same conditions apply to London, and to the Universities of Scotland, Ireland and the provinces ; except that the fees are proportionately lower, and that most of these universities have their own schools of medicine and hospitals.

But, eliminating altogether the subject of universities, there are throughout the country numerous medical schools. Medical degrees are only granted by the universities ; but diplomas — L.R.C.P. and M.R.C.S. — are bestowed by the Colleges of Physicians and Surgeons. It should be remembered, of course, that the obtaining of public appointments depends very largely upon the actual degree of the prospective candidate ; and it may be mentioned that the degrees of the London University rank very high in the profession.

Doctors who have qualified at the Scottish Universities and medical schools are much sought after ; and training in Scotland, Ireland and the provinces may, generally speaking, be said to be cheaper than that of London, or of Oxford and Cambridge.

Medical men who have passed their final professional examination may, of course, begin at once to practise ; but the first few years in a young doctor's life are generally spent at some more or less unremunerative post. He may become second or under house surgeon at a small hospital ; assistant to a practising doctor, or he may go to sea as a ship's doctor.

Still, the demand for qualified men is now so great, that there is little likelihood of this period being anything but a short one. Eventually, perhaps sooner than later, the young medico may rise to hold a municipal post ; to own his own practice ; or to fulfil some other duty. There are vacancies for doctors in all sorts and conditions of schools

and institutions, prisons, workhouse infirmaries and the like, and such appointments are often advertised in the columns of the medical newspapers, where the announcements of medical schools also appear.

Army doctors—who figured by the hundred in the Honours lists in the Great War—are appointed under the regulations of the Royal Army Medical Corps ; Naval doctors come under the Admiralty ; prisons doctors under H.M. Prison Commissioners. As for the various councils—Metropolitian, borough, city, urban and rural—their advertisements for medical officers of health appear in local newspapers, in the *Municipal Journal*, and also in the medical press.

There is, further, that large and important branch of work the Indian Medical Service, fully touched upon in a former lesson ; and in most branches of Government service the worker may anticipate a pension and liberal allowances.

Lady Doctors are becoming more and more in demand. Under the Factory Acts and Public Health Acts they are employed officially ; and are also to be found in the service of the General Post Office. Moreover, during those years when there were comparatively few male medical students the number of lady students actually increased and all sorts of hospitals and institutions devoted to the care of women and children are appointing medical officers and house surgeons of the gentler sex.

In London the Royal Free Hospital School of Medicine offers special facilities for the training of lady doctors.

The time occupied by a woman student in obtaining her degree or diploma would probably be about five or six years ; and during that time she should be able to rely upon an income of not less than £3 per week to meet her living expenses and the cost of training and instruments.

There is a demand for lady doctors in India ; and to a certain extent in other dependencies ; and women are more and more likely to find congenial and remunerative occupation in the medical profession.

Up to a point, the training of *Dental Surgeons* runs much along the lines prescribed for doctors. The candidate has to be registered by the General Medical Council and to pass a preliminary educational examination ; or to produce certificates that he has satisfactorily weathered one of the tests set by the Council.

Would-be dentists may, however, begin at a rather earlier age than doctors ; though they may not practise until they are twenty-one. A youth who decides to take up dental surgery may commence his career at 17 or 18 years of age and serve a kind of apprenticeship for three years under a dental surgeon for the study of what is termed mechanical dentistry ; or he may enter a dental hospital and obtain his mechanical experience in that way. The fees for apprenticeship vary, and may be as much as a hundred guineas.

Following upon this term, there usually comes a period of study and lectures in surgery and such matters at a general hospital ; and attendance at a dental school is also advisable.

It costs a good deal less to become a dentist than a doctor. The fees for the examinations and diplomas amount to between £20 and £30. A. C. M.

BOOK-KEEPING.—XXI

Self-Balancing and Sectional Ledgers

It has been noticed that the Ledger is the book through which every transaction in double entry book-keeping passes. Now, in a large concern the Ledger will not be one but many books, and it is often found convenient to divide the books in some scientific way, say into

i. **Bought Ledger,** which will contain creditors' accounts, and from which balances of " Sundry Creditors " will be extracted.

ii. **Sales Ledger,** which contains debtors' accounts and from which balances of "Sundry Debtors " will be extracted.

iii. **General Ledger,** which will contain real accounts.

Again the Bought and Sales Ledgers may be subdivided when accounts are numerous. Each Ledger will contain a *section* only of the creditors' or debtors' accounts. Ledgers may be *sectionalised.*

(*a*) **Geographically ;** that is, say, Town, Country, Foreign ; or London, Manchester, Liverpool, and Various.

(*b*) **Alphabetically ;** according to the name at the head of the account, thus : one ledger may contain all accounts with names A to G, another H to O, and a third P to Z.

(*c*) **Departmentally ;** thus :—Furniture Department, Glass and China Department, or A Dept., B Dept., etc.

If the Ledger is all one book we have seen that we can extract the balances and prepare a Trial Balance to prove the accuracy of our entries. If, however, the Ledger con-

tains only sales, and perhaps only part of these, say sales of Furniture Department, it will be difficult to prove the accuracy of the entries without extracting balances from all ledgers. Should the Trial Balance prove wrong, there is no clue to the particular Ledger containing the error, and the labour of localising such error is very great.

Self-Balancing Ledger

A particular Ledger can be accurately tested if the subsidiary books are analysed.

Let us see what the Sales Ledger for Furniture Department balances will be equal to :—

If we take outstanding balances at the beginning of a financial period and add to these sales during the period we shall have the balances at the end of the period if no payments or returns are made. If payments in cash or bills are made, we must deduct these from our total ; returns, bad debts and discount will also be deducted and the result will be equal to the balances in the Ledger. It may be that a bill is dishonoured ; if so, this is added back with any charges, and any small items that have been debited or credited to the accounts in the Sales Ledger will be credited or debited in the above calculation, e.g. carriage charged to purchasers will be added on.

We have therefore :—

Thus at any time the person in charge of the books may check the total balances as notified by the clerk in charge of a particular Ledger. To this extent the Ledger is self-balancing.

The above forms no part of the system of double entry, but may be entered at the end of the Ledger for reference and marked for "Memo" only. Some exponents of the art of book-keeping make this check a part of the system of double entry. There is little advantage in it, but as it is a theoretical principle and required by examiners the method may be explained.

Adjustment Accounts

From these details an Adjustment Account is built up. The balance of this account exactly equals and is opposite to the total balances in the Ledger. A further fictitious account equal and opposite is raised in the General Ledger to complete the double entry.

In a recent Royal Society of Arts Advanced Grade Examination the following test was set :—

John Garside keeps his "Sales Ledger" upon the "self-balancing" principle.

Prepare the necessary "Adjustment Account" as on January 31st, 19.. ; all the particulars necessary for preparing this will be found at the top of the next page (p. 182).

19..		£	s.	d.	£	s.	d.
Jan. 1	By Balance (total debtors on Jan. 1st, 19..) say	1,000	–	–			
,, 31	,, Sales	4,000	–	–			
,, ,,	,, Bills Dishonoured	100	–	–			
					5,100	–	–
Jan. 31	Less Cash	2,000	–	–			
	,, Discount	100	–	–			
	,, Bills Receivable	500	–	–			
	,, Returns and Allowances	50	–	–			
	,, Bad Debts	50	–	–	2,700	–	–
	Difference equals total debtors as per Sales Ledger, Furniture Dept.				£2,400	–	–

The above is merely a memorandum for checking the accuracy of the balances in a particular Ledger without reference to other Ledgers.

A Bought Ledger may be treated in a similar manner, thus :—

	£	s.	d.	£	s.	d.
Balances of Creditors at Commencement of Period	–	–	–			
Purchases During Period	–	–	–			
				–	–	–
Less Cash Paid	–	–	–			
,, Discount Received	–	–	–			
,, Bills Payable	–	–	–			
,, Returns Outwards	–	–	–	–	–	–
Difference equals total creditors as per Bought Ledger				–	–	–

19..			£	s.	d.
Jan.	1	Total debtors' debit balances at this date were	12,542	–	–
,,	31	Total goods sold to customers for the month	21,658	–	–
,,	,,	Total goods returned by customers for the month	942	–	–
,,	,,	Total cash received from customers for the month	15,621	–	–
,,	,,	Total discount allowed to customers for the month	968	–	–
,,	,,	Total acceptances received from customers during the month ..	3,471	–	–
,,	,,	Total acceptances dishonoured by customers during the month ..	542	–	–

The Sales Ledger Adjustment Account would appear in the General Ledger as follows :—

Dr. SALES LEDGER ADJUSTMENT ACCOUNT. *Cr.*

19..		£	s.	d.	19..		£	s.	d.
Jan. 1	To Balance (debtors at this date) ..	12,542	–	–	Jan. 31	By Cash	15,621	–	–
	,, Sales	21,658	–	–		,, Discount	968	–	–
	,, Cash (dishonoured bills)	542	–	–		,, Bills Receivable	3,471	–	–
						,, Returns	942	–	–
						,, Balance c/d ..	13,740	–	–
		£34,742	–	–			£34,742	–	–
Feb. 1	To Balance b/d ..	£13,740	–	–					

The General Ledger Adjustment Account will appear in the Sales Ledger as follows :—

Dr. GENERAL LEDGER ADJUSTMENT ACCOUNT. *Cr.*

19..		£	s.	d.	19..		£	s.	d.
Jan. 31	To Cash	15,621	–	–	Jan. 1	By Balance (debtors as at this date) ..	12,542	–	–
	,, Discount ..	968	–	–		,, Sales	21,658	–	–
	,, Bills Rec. ..	3,471	–	–		,, Cash (dishonoured bills)..	542	–	–
	,, Returns	942	–	–					
	,, Bal. c/d	13,740	–	–					
		£34,742	–	–			£34,742	–	–
					Feb. 1	By Balance b/d ..	£13,740	–	–

Bought Ledger Adjustment Accounts are raised in a similar manner from the pro forma memorandum shown above. In the General Ledger the "Bought Ledger Adjustment Account" will show a credit balance, whilst the "General Ledger Adjustment Account" in the Bought Ledger will show a debit balance of equal amount.

Any sectional ledger may be made self-balancing in the above sense if the subsidiary books are properly analysed. Thus the Cash Book ruling for sectional balancing where the Sales Ledger is subdivided into departments would be :—

CASH BOOK

DATE.		PARTICULARS.	FOLIO.	DISCOUNT.			OFFICE.			BANK.		
19..				£	s.	d.	£	s.	d.	£	s.	d.
Jan.	1	To Balance								5,000	–	–
,,	4	,, John Smith		5	–	–				60	–	–
,,	5	,, Tom Browne					5	–	–			
		Etc.										
		Etc.										

These items would be carried into dissection columns under the following heads: Bought Ledger; Sales Ledger (Furniture; Curtains, etc.; China and Glass; Hardware; Silver, Cutlery, etc.); General Ledger.

Both sides of the Cash Book may be alike, but the column "Bought Ledger" on the receipts side is seldom required. It might well be that a repayment is made by a person who has overcharged, in which case the column is required.

Where the Ledgers are very numerous the usual Cash Book ruling is used and analysis sheets are prepared.

Bill Books, Returns Books, Sales Books, etc., are similarly analysed.

Definitions of Terms

Sectional Balancing.—The balancing of a Ledger containing a section only of the open accounts. This is done by raising an "Adjustment Account" as described in the lesson.

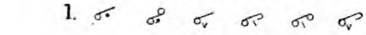
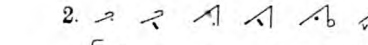
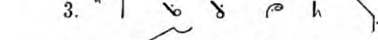
F. H.

SHORTHAND.—XIV

Key to Exercise 49

1. hat, hats, height, heights, haunt, haunts, hut, huts, hunt, hunts.
2. raft, rafts, rent, rents, round, rounds, rant, rants, rate, rates.
3. roots, right, routs, rights, rats, wrought, wrote, rut, ruts.
4. suet, fiat, hotels, pats, pants, pads, bind, retained, writing.
5. *We-shall-be* pleased *to*-sell *you the cart you called to see* last Friday *for* ten pounds.
6. *According-to-the* accounts *of*-persons *who* were present, Tom *cared* little about-*the* accident *at-the* market.
7. *The cold* weather *has-not-been equalled for* five *years.*
8. *The* bank *has a* good store *of-gold in-its* vaults.

Key to Exercise 50

1. 
2. 
3. 
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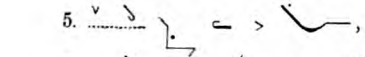
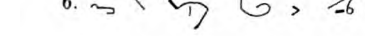
5. 
6. 

Md, nd, ld, rd.—These combinations of letters are often found in words, and we have a special method of representing them. The forms

mt *nt* *lt* (up) *rt*

are thickened, as follows—

md *nd* *ld* (down) *rd.*

Here are a few examples of their use—

timed, *end,* *fold,* *bird,*
chimed, *stained,* *stemmed,* *mild,*
stirred.

However, your attention is drawn to the following—

need, *mud,* *annoyed,* *humid,*

where the thickened half-length sign is used when a vowel occurs between the *n-d* and the *m-d;*

followed, *mellowed,* *borrowed,*
carried,

where the thickened forms for *ld* and *rd* are not used, because a vowel comes between the *l-d* and the *r-d.* This, of course, is necessary and you must follow it in writing such words.

Words which contain *mp-t, mp-d, ng-t, ng-d,* cannot be represented by the half-length thickened forms mentioned above; hence we write—

impute, *impede,* *wronged.*

When *ng, mp, mb* are hooked they may be halved for *t* or *d;* thus—

lingered, *whimpered,* *scampered,*
drunkard, *dampened.*

Rt, lt.—*Rt* is generally written upward; and *lt* is written upward, except after *n, ng;* thus—

port, *chart,* *mart,* *alert;*
pelt, *dealt,* *felt,* *quilt,*
knelt, *ringlet.*

Lt and *rt,* written upward, may be used for *ld* and *rd,* when it is not convenient to write and ; thus—

lard, *Pollard,* *mildly.*

Ward, wart, wort.—The sign is used to represent these syllables, as in—

backward, *stalwart,*
moonwort.

Yard.—This may be represented by ; thus—

stockyard, *backyard.*

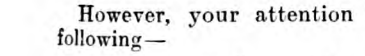
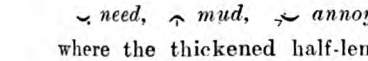
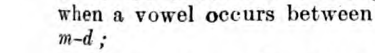
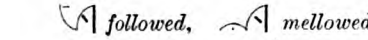
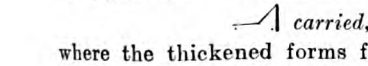
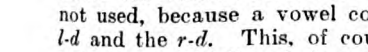
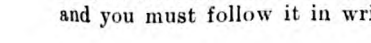
Shun and -ist.—After the *shun* hook *st* may be written upward where the downward form is awkward; thus—

impressionist, *educationist.*

Exercise 51

GRAMMALOGUES

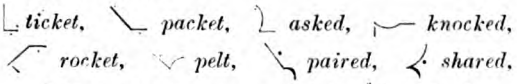
gentleman, *gentlemen;* *child;*
particular, *opportunity.*

1.
2. 
3. 
4. 
5. 
6. 
7. 
8. 

Key to Exercise 51

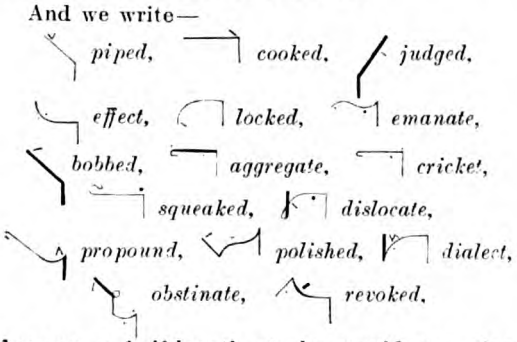
1. made, aimed, mode, mad, mud, hemmed, amid, seemed, stemmed, summed.
2. end, owned, need, nod, send, sound, signed, stained, sand, sinned.
3. old, load, fold, followed, killed, collide, rolled, rallied.
4. aired, raid, heard, harried, cured, curried, stored, steered.
5. fingered, clambered, Bert, start, merit, dirt, sunlight, melt.
6. *in*ward, *out*ward, milkwort, downward, southward, fashionist, protectionist.
7. *The gentleman* gave *the child an opportunity of see*ing *his* treasures.
8. *These particular gentlemen* were *given* time *to* execute *the* contract.

Strokes of Unequal Length.—When we have strokes of unequal length we must take care that the joining is easily seen, otherwise the half-length form must not be written; hence we write—



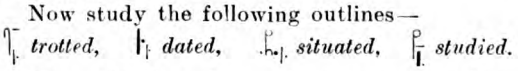
because the junction is evident, either by an angle or a difference of thickness.

And we write—



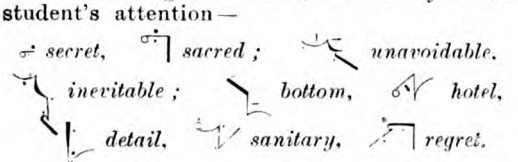
because a half-length stroke would not give an evident joining.

Now study the following outlines—

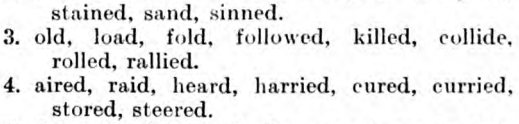


We notice that the words are represented by *three* straight upright strokes, and in writing the final syllable *-ted*, or *-did* we use a half-length *t* or *d* and disjoin it. This is because three straight upright strokes, when joined, make too long an outline. Here, again, as in many previous instances, easiness of outline has our first consideration.

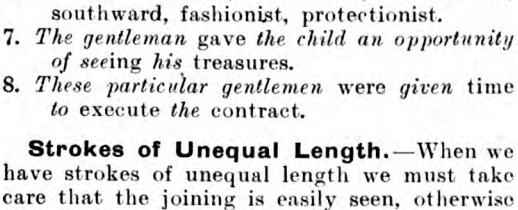
The following forms, also, are worthy of the student's attention—



Past Tenses.—In past tenses *-ted* or *-ded* is always represented by a half-length *t* or *d* respectively; thus—

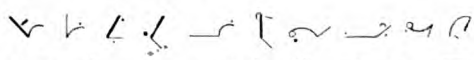


Phrasing.—The following examples show the use of halving for securing some very useful phraseograms—



Exercise 52

GRAMMALOGUES

1. 
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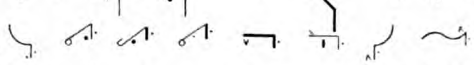
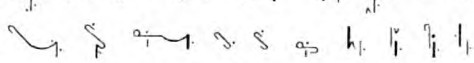
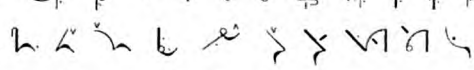
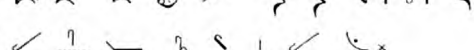
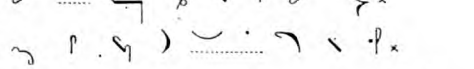
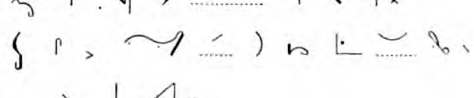
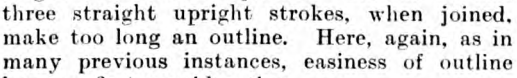
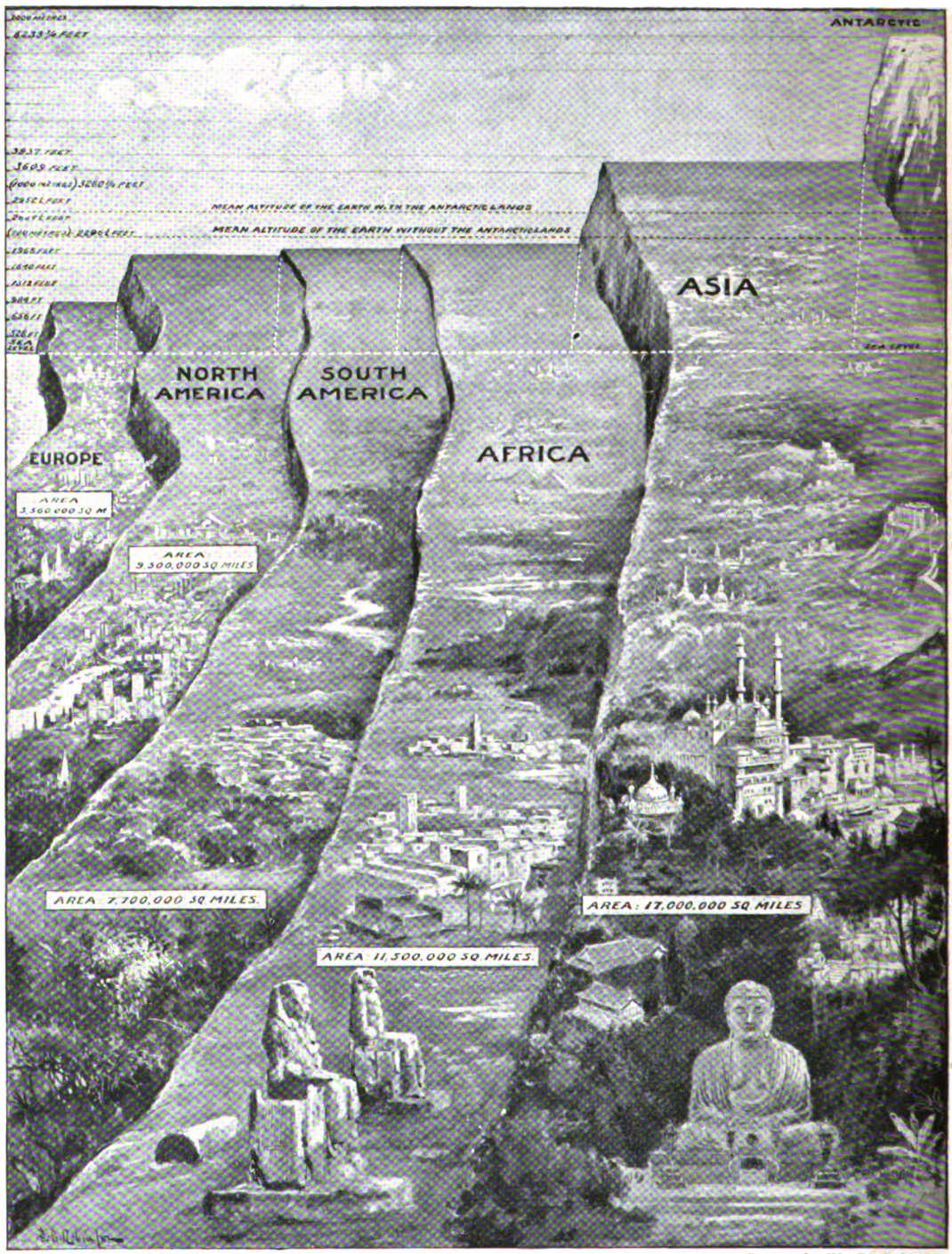
3. 
4. 
5. 
6. 
7. 
8. 

Exercise 53

GRAMMALOGUES



1. fact, packed, locked, elect, select, rocked.
2. matted, routed, noted, granted, minted.
3. spot, proud, bent, plotted, trammed, dared, send, felled.
4. *We-will-see that-the* affair *is put* right.
5. *The* editor said *they-would-be able-to* manage *without his* services.
6. *Our member was chaired and cheered on his* return *from-the* field *of* action.



Drawn by W. B. Robinson.

THE CONTINENTAL STAIRWAY.

An estimate, based on meteorological calculations, of the relative mean heights of the world's continents, and showing how the known world is overshadowed by the unknown tracks of antarctic land. The marginal scale on the diagram is divided into sections of 100 metres, but the figures are given in English feet.

Continued from page 127.

ENGLISH LANGUAGE AND LITERATURE:

***Contributors*:**—ENGLISH LANGUAGE (W. A. Craigie, M.A., LL.D.; E. W. Edmunds, M.A.). ENGLISH LITERATURE (John Derry, J.P.). PHILOSOPHY (E. H. Tripp, Ph.D.). POLITICAL ECONOMY (J. W. Urwin). ETHICS (W. H. Koebel). PUBLIC SPEAKING (J. W. Urwin).

PHILOSOPHY.—V

In the foregoing lessons we have been careful to avoid, as far as possible, the use of the words "cause" and "effect." The materialistic position might have been put in the form: matter, or matter in motion, is the cause of mind; and the spiritualistic standpoint in the form of: mind is the cause of matter. The words "cause" and "effect," however, are so often employed in a loose, ambiguous manner—according to W. K. Clifford the word "cause" was used by Plato in sixty-four senses and by Aristotle in forty-eight—that it is imperative to try to arrive at some clear, precise connotation before proceeding further.

Law of Causation

Reality, as it appears to us, consists of practically an endless number of phenomena, events or happenings which follow one another in definite sequence; friction gives rise to heat, a spark brings about the explosion of a mixture of hydrogen and oxygen, a high wind spells a rough sea, a drop in temperature follows the setting of the sun, and so on almost *ad infinitum*. A closer study of such phenomena reveals to us that although many of them occur concurrently, yet in the great majority of cases they follow one another in invariable succession. If an event B has been observed to follow an event A, then this sequence is always repeated when the conditions remain the same.

Such is the universal experience which has been formulated in the Law of the Uniformity of Nature, or as it is sometimes called the Law of Causation. What is the peculiar characteristic of a sequence A—B to which the causal relation can be applied? Is it invariability alone? (J. S. Mill.) Or is it that the event A has an inherent power which compels the occurrence of B? (the vulgar standpoint). The study of any single occurrence soon convinces us that it is not the result or consequent of a single antecedent, but of many.

A man steps off a railway platform on to the line and is killed by a passing train. The events preceding this fatal act were:—he willed to do so, he was tired of life, his health was bad, his body ill-nourished, his mind depressed by monetary losses; and preceding each of these events or states is a long chain of antecedent events or conditions.

Following the tragic act we have: the inquest, burial, widow and offspring left penniless, friends subscribe to their support, the children are educated, etc., etc. Such is a common sequence or chain of events.

Now, which of the antecedent events shall be singled out as *the* cause of the tragedy? In everyday life it is common to select one only of the antecedents, and very frequently that one which appears at the time to be the most important, or one which has all the appearance of immediately preceding the given event; but such procedure is to a large extent arbitrary and cannot be sufficiently exact for science or philosophy.

Liability to Error

Much confusion of thought and many errors of judgment emanate from the tendency of the uneducated to predicate a single "cause" when many have been operative. Then, again, it is necessary to distinguish between "events" and "conditions." A man treads on a piece of orange peel, falls, and hurts himself. The treading on the peel would probably be singled out as the cause, and of the other circumstances which led up to the act, the throwing of the

peel on the pavement by a careless person, would also be an antecedent event, and the man's absent-mindedness, and the neglect of the street cleaners to remove the peel would be regarded as antecedent conditions.

It may be noted *en passant* that the two conditions mentioned in this case are of a negative character ; and even a negative condition is often taken to be *the* cause of an event, e.g. the ship struck a rock because the man on the look-out failed to give the alarm.

Is Day the Cause of Night ?

With the exception of such negative conditions, a distinction may be drawn between an event and a condition based on the circumstance that the former occurs in a definite and usually short period of time, whereas a condition persists for a longer and often an indefinite time. Fundamentally they are of the same order, both being " phenomena." In any case, as John Stuart Mill pointed out, it is illogical to select one or a few only of the antecedent events or conditions of a given occurrence and to term it the " cause " : the cause should rather be regarded as the *totality* of the relevant events and conditions which precede it. It is obvious that no individual can know all of these, but the greater and more accurate his knowledge the greater will be his ability to predict the recurrence of the given event.

It has been indicated above that J. S. Mill regarded invariability of succession as a criterion of causation. Against this view it has been urged that day and night invariably follow one another, yet no one would think of calling day the cause of night, and night the effect of day, or *vice versa*. To meet this difficulty, Mill added that the sequence must be unconditional. The succession of day and night is conditional upon the rising of the sun, i.e. upon the rotation of the earth on its axis. It appears to the writer that this explanation is defective.

In the first place, the words " day " and " night " connote essentially periods of time, the former that period when a particular part of the earth's surface is illuminated by the sun's rays, and the latter the time interval during which that surface is not so illuminated. Now succession is the essence of time, and no one would for a moment regard successive instants or intervals of time as standing to one another in the relation of cause and effect. Time cannot be regarded as a phenomenon or event in the ordinary sense. Secondly, is it not highly probable that every sequence in nature is conditioned by events or other sequences ? And is not this truth included in the Law of the Uniformity of Nature ?

It might be contended that " day " and " night " connote only states of illumination of the earth's surface, in which case it may be asked if such states or conditions of matter can be regarded as events in the ordinary acceptation of the word. When physical events are viewed in the light of the principle or doctrine of energy—the standpoint of modern physics—it is observed that their succession is attended by a transfer or transformation of energy between them, but there is no such transfer or transformation (conversion of one form of energy into another) between successive states of illumination or temperature of one and the same body.

Thus we can call the proximity of ice the cause (in the sense of J. S. Mill) of the sinking of the mercury in a thermometer, for it involves a transference of heat from the latter to the former ; but we cannot call the high temperature of the sea in summer the cause of its low temperature in winter (an invariable sequence), for there is no communication of energy between these successive states. In a conducting wire joined at its extremities to the two poles of a battery, the potential at any one point is invariably followed by a lower potential at the next point (in the direction of the current) ; but no electrician would call the higher potential the cause of the lower. For a similar reason the ebbing tide cannot be causally connected with the flowing tide. It would appear, therefore, either that such states or conditions as illumination, temperature, etc., are not " events " in the ordinary (and Mill's) acceptation of that term, or that invariability of succession is not always to be regarded as a criterion of causation.

Causation as Force or Necessity

We must now pass on to the consideration of the common view that the observed sequences in nature are inevitable or " necessary."

The notion or concept of causation is usually associated by the lay mind with that of force, power, or compulsion, the cause being regarded in a sense as compelling the effect. The force of gravity " compels " the planets to keep in their orbits round the sun ; falling water " makes " the mill-wheel revolve ; the advent of wintry weather " forces " some birds to migrate ; and so on.

This idea of compulsion in nature doubtless originates in the consciousness of man of his limited although real power to set

objects in motion or to bring them to (apparent) rest. As we have seen in Lesson II, p. 379, primitive man—primitive in point of view of enlightenment as well as of time—attempted to explain natural phenomena by *reading into* nature beings (demons or deities) possessing his own attributes in a magnified degree; and among these attributes were his own desires and volitions and his power of attaining them. Every serious student of natural science is aware that such conceptions are entirely inadequate and superfluous in the interpretation (i.e. the description, measurement and correlation of phenomena) of nature to-day. It is true that the science of mechanics, superficially regarded, lends some colour to the primitive view; as Karl Pearson says, some more or less superficial works on natural science give currency to the notion that mechanics supplies a code of rules which nature of inherent necessity obeys. We are told that mechanics is the science of force, that force is the cause that produces or tends to produce change of motion, and that force is inherent in matter; but this concept of force as a cause of motion has been replaced by force as a measure of motion, and the later-day scientist speaks of energy where his forbear spoke of force.

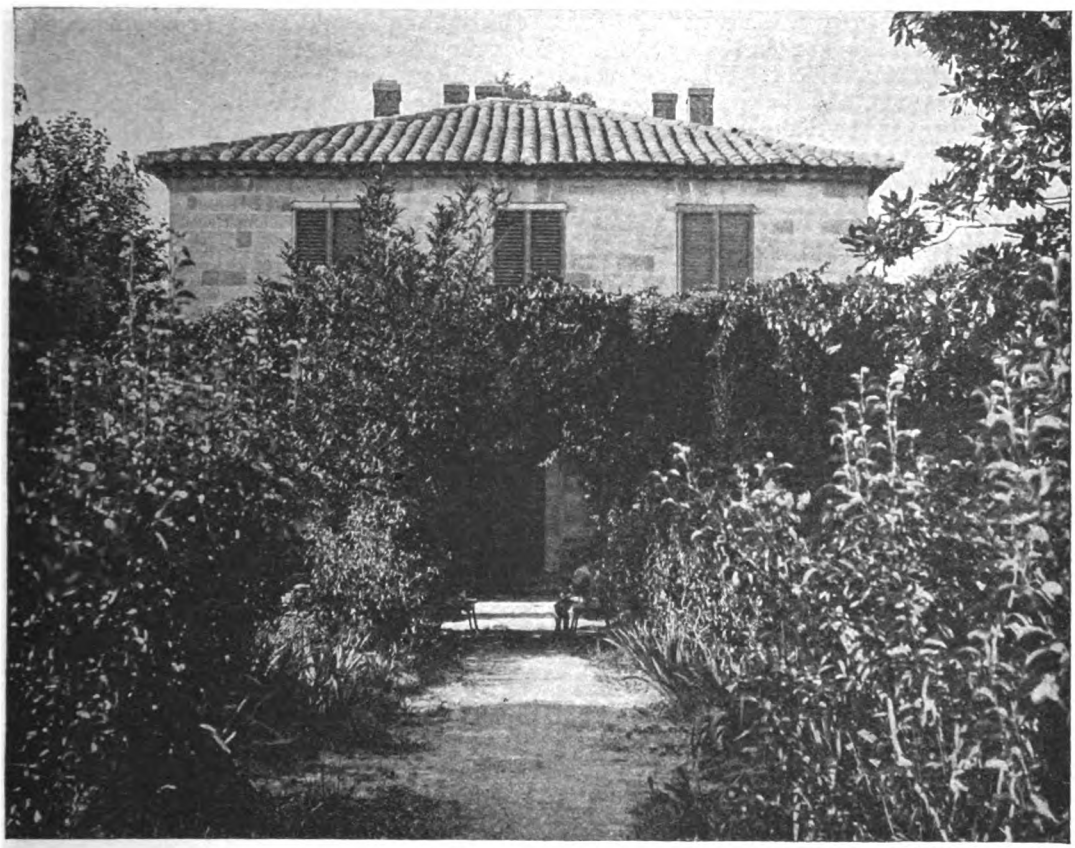


Photo: D. Macleish.

JOHN STUART MILL'S HOUSE AT AVIGNON,

where the great philosopher and political economist lived for six months in every year in order to be near the grave of his wife, who died in 1858.

The idea of necessity as inherent in the causal relation is equally obsolete. Invariability of succession as between two events A—B signifies merely that it is our uniform experience that if A happens B happens also, and the Law of the Uniformity of Nature (Law of Causation) is but a generalised expression of the same truth. That B will follow A is not in any sense logically necessary; we can quite easily conceive the contrary. In fact it is extremely doubtful if the notion of logical necessity is applicable outside the provinces of formal logic and mathematics. In the syllogism:—All successful politicians play to the gallery; Tom Smith is a successful politician; there-

fore, Tom Smith plays to the gallery; so, if the truth of the major and minor premisses be granted, it follows *necessarily* that the conclusion is correct. Similarly in Euclidean geometry, if we assume a straight line to be the shortest distance between two points, it follows *necessarily* that two straight lines cannot enclose a space—the converse is unthinkable. In such cases the necessity involved is in *conception* or thought, not in *perception* or experience. What is valid mentally is not on that account valid perceptually. In the realm of experience the seeker after truth must be content with probability—the guide of life, as Bishop Butler called it.

The Determining Factor

Having purified the concept of causation from inherent force and logical necessity, it would be well if we could impart to it some more concrete, positive connotation than where we left it as defined by J. S. Mill, and to this end we may learn something from the method of experimental science. It is noteworthy that the word "cause" is tending to disappear from scientific treatises, a result which is doubtless due to the ambiguity of the term, and that instead of postulating causes the terms "factors" and "determining factors" are employed.

The existence of such factors can be established in several ways. Suppose an event or phenomenon V is under investigation and we wish to discover which, if any, of the events or conditions a, b, c, d, e are operative in bringing it about, we may so devise the experiment that b, c, d, and e are eliminated, and then observe if the event V takes place; if it does we call *a* a determining factor. Or we may arrange the experiment so that b, c, d, e are all present and a is omitted; if V does not ensue, a is a determining factor; if V occurs as before, a is ruled out as a determining factor; if V still occurs but in an altered degree, a is a factor but not a determining factor.

In a similar way we may proceed to determine the relationships between b, c, d, e, and V, or between pairs or triplets of the supposed factors and V, and further it is usually possible to ascertain quantitative as well as qualitative data concerning them. In common parlance it will be said that a determining factor is "necessary" to the occurrence of V, but if we use this adjective we must bear in mind that it is not synonymous with logical necessity, it merely signifies "without which . . . not."

The above procedure is known as the "method of elimination." It is, however, not always possible to pursue it, inasmuch as it may not be possible or expedient to eliminate the several factors. In such a case it may be practicable to proceed by changing one factor at a time and observing the alterations which V undergoes; in other words we may experiment with a view to ascertaining if one event or condition is a function of another.

Ability to use these methods confers a great advantage on the practical sciences (such as physics, chemistry, agriculture, biology, etc.), but obviously they are not applicable to all; for example, in geology, we cannot put back the hand of Time and reproduce the conditions which resulted in the manifold alterations of the earth's crust. But in this case, and in other branches of knowledge, we can derive assistance by applying the principle of analogy; and in the case of geology, where the changes were essentially physical and chemical, it is possible to apply experimentally verifiable data and laws from physics and chemistry in reasoning about phenomena which occurred in the remote past.

The concept "determining factor" is, we believe, practically identical with the purified concept of "cause" elaborated in the earlier part of this lesson, and it has the advantage over J. S. Mill's conception in time; but each connotes some thing, event, or condition in the absence of which another event or condition does not take place. The notion of "cause" as the totality of antecedent (or concomitant?) events and conditions is philosophically sound but impossible of application, as it implies an omniscient intelligence.

Summary

The word "cause" is and has been used in a loose, ambiguous manner; the word has remained unchanged, but its meaning has undergone many alterations.

Events or phenomena present themselves to our consciousness in ordered and invariable sequence (Law of Uniformity of Nature).

A given event is preceded by many antecedent events and conditions, one of which is usually selected arbitrarily as the cause.

According to Mill, causation implies unconditioned invariable sequence between phenomena, and the cause is the totality of the antecedents.

There are invariable sequences to which the concept causation is inapplicable.

The notion of compulsion or necessity as applied to sequences of phenomena is fallacious.

The concept "determining factor" affords a satisfactory working connotation of the term "cause."

E. H. T.

Continued from page 132.

HISTORY:

Contributors:—J. A. Brendon, B.A.(Oxon.), F.R.Hist.S.; F. Collinson, F.R.Hist.S.; T. P. Evans, B.A.(Oxon.); James A. Manson; L. Stampa, M.A.(Oxon.); and J. B. Sterndale-Bennett.

THE REVOLT OF THE NETHERLANDS

THE Emperor Charles V., though fully conscious of the depravity, weakness and corruption of the Roman Court, was a good Catholic. He could see no virtue in Lutheranism or any other "heresy," and looked on such things as dangerous innovations. On the other hand, however, he had no wish to suppress them by persecution if only the unity of the Empire could be attained by other means; and he was largely instrumental in calling together the famous Council of Trent, which opened its deliberations in the year 1545, with a view to putting an end to the schism in the Church, and inaugurating practical reforms.

The Counter Reformation

Two years later, in 1547, a quarrel between the Emperor and Pope Paul III. brought the sittings of the Council to an untimely end. In 1551, however, Paul's successor, Pope Julius, resummoned the Council, and, at the urgent request of Charles, allowed its meetings to be attended by Protestants. None the less, fair discussion was made impossible; and the Protestants, finding this to be the case, withdrew once for all. Charles' attempts at reconciliation had failed completely, and in 1552 the Council was again suspended.

The absence of the Protestants, one might think, would have simplified the task of the delegates when they met for the third and last time in 1562 under Pius IV. But this it did not do; the French and the German representatives still pressed for drastic changes that would satisfy the Protestants.

Their demands were quite unacceptable to the majority of the Council. Still, many salutary reforms were effected, and the deliberations of the Council of Trent deserve a prominent position in the history of the Counter Reformation movement.

In connection with the Counter Reformation—that is to say, the reformation of the Church from within—should also be noted the rise of several new religious orders, such as the Theatines and the Jesuits. The latter especially—however much they may later have abused their powers—instilled new life into the whole body of the Church.

The Inquisition started by Cardinal Caraffa (afterwards Paul IV.) was the means of stamping out Protestantism in Italy and Spain; whilst in Ignatius Loyola, the founder of the Jesuits, and his followers, Xavier, Lainez and Peter Faber, Protestantism found everywhere in Europe determined, relentless enemies. Charles V., however, wished to win over and reconcile the Protestants of Germany. Indeed, it was with this object in view that he had persistently urged upon the Pope the calling of the Council of Trent. Yet, for some strange reason, he displayed no such consideration for the Reformers in the Netherlands. There he determined to exterminate "heresy," and by several decrees, notably that of 1550, men holding heretical opinions were condemned to the stake, women to be buried alive. Moreover, penalties almost equally severe were enforced against those who harboured heretics, attended conventicles, or even disputed on the Scriptures.

Abdication of Charles V.

But Charles never forgot that he was Flemish born, and he was by no means an unpopular ruler. Careful to avoid appointing Spaniards to office in the Netherlands, he often raised Flemings to high posts in Spain. The Estates General was frequently summoned. In fact, despite heavy taxation, the country probably was never more prosperous than in the year 1555, when the great Emperor solemnly abdicated at Brussels, and handed the reins of government to his son Philip.

At this time the Catholics greatly exceeded the Reformers in number, and included most of the great nobles, a fact important to remember in connection with the be-

ginning of the revolt against the Imperial authority.

When Philip succeeded, he almost immediately alienated the affections of the people by his cold manners and haughty airs; and his declaration to the effect that he would rather give up his throne altogether than rule over heretics caused uneasiness in the minds of all. His first acts of government, moreover, were harsh and unpopular; and there was something like a general sigh of relief in the country in 1559 when he left Brussels never to return.

The Regency

The appointment of Margaret of Parma, Philip's half-sister, as Regent, was not unpopular, for Margaret had been born and brought up in the country, and bore it affection, as well as being a capable governor. Nominally she ruled by the advice of three Councils. The real power, however, lay in the hands of an inner junta—the *Consulta*—which consisted of three members: the Bishop of Arras, or Cardinal Granvella as he afterwards became; and two Flemish noblemen, Viglius the President, who was a jurist and a friend of Erasmus, but mercenary in the extreme, and subservient to his stronger colleague; and Count Berlaymont, a Fleming of good birth, but narrow of view and despotically inclined.

The Regent, on Philip's departure, immediately found herself confronted with difficulties. The people, already discontented by reason of the presence of the Spanish troops, were in no mood to appreciate violent changes of any kind, and when a scheme of making new bishoprics, twelve in number, was promulgated, a storm of disapproval arose on all sides, since it was feared, and feared rightly, that an increase of episcopal power would mean an increase in the stringency of the Inquisition.

Political and religious malcontents were at once united in opposition. An attempt was made to rescue certain victims of the Inquisition at Valenciennes. This was followed by a more active opposition to Cardinal Granvella, and when William of Nassau led the opposition an agitation for the Cardinal's removal was started.

Counts Egmont and Horn

A letter was written to the King signed by Prince William and the Counts Egmont and

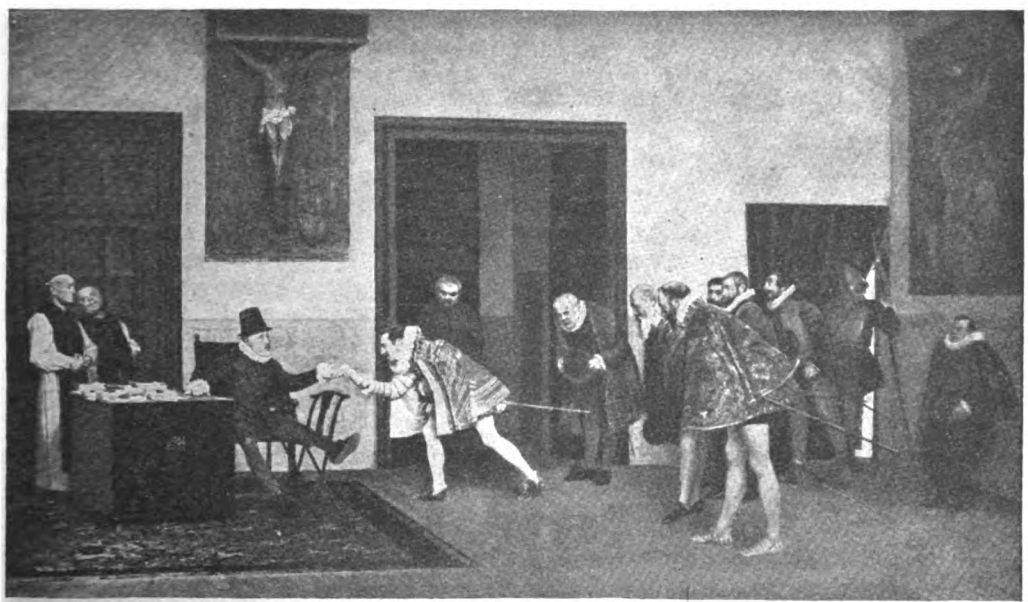
From the picture by De Biefve in the Brussels Museum.

The formation of the League of the Nobles of the Netherlands who, under the leadership of the Prince of Orange, Count Egmont (seated in the right foreground) and Count Horn (signing the book), banded together to force Philip II. to modify the harshness of his rule.

Horn, with the approval of the Regent Margaret, asking for the dismissal of the Cardinal. This request Philip grudgingly granted, but he then published the resolutions of the Council of Trent, with a direction that the edicts against heresy were to stand.

Again a storm of indignation arose, and the Prince of Orange and the two Counts impressed upon the Regent the desirability of summoning the Estates General and reforming the administration. In furtherance of this project, and with the sympathy of their followers in the Netherlands, having adopted the name of The Beggars (*Les Gueux*), presented a less reasonable petition to the Regent. This was an unwise proceeding on their part, and it was followed in Flanders by an unfortunate iconoclastic outbreak which extended over the greater part of the country.

Hundreds of churches were sacked. Books, shrines, images were everywhere destroyed. Criminals joined the fanatics, and for a time anarchy prevailed.



From the painting by Del Arco.

Philip II. of Spain at the Escurial Receiving a Deputation from the Netherlands.

Margaret, Egmont was sent to Spain to interview the King. Philip, however, refused to listen, and, after a long delay, replied definitely refusing to sanction any change of administration, and insisting that the edict against heresy must be strictly enforced.

This decree created much consternation in the Provinces, and William of Orange "saw the beginning of a fine tragedy." The Regent and her Councillors tried to warn Philip of the dangers ahead, the opposition having threatened in very strong terms to resist the King's decree. Eventually a petition more moderate in tone was delivered to the Regent. This was sent to Spain, the Regent promising to suspend the edicts in the meanwhile.

On receiving this petition, Philip undertook to abolish the Inquisition, and promised other concessions. His intentions, however, were insincere.

Meanwhile the leaders of opposition and the principal nobles, including William and the Counts Egmont and Horn, rallied to the Government and helped to restore order, while the extreme section, in their own defence, rose in rebellion, but they were soon suppressed by the Royal troops. Philip now resolved upon stringent measures, and appointed the Duke of Alva to carry out a congenial task of stamping out heresy and punishing the people.

Alva arrived at Brussels in 1567 with 10,000 Spanish troops. Margaret at once resigned her position. Walloon soldiers were then replaced by Spaniards; and the work of blood began. Enticed to a council, Counts Egmont and Horn were treacherously arrested.

The "Council of His Excellency," better known as the "Council of Blood," was appointed, and the work of vengeance went on apace, thousands of Protestants being executed and their goods confiscated, after a trial less than nominal.

When these proceedings became known generally in Europe, the Protestant Powers were deeply moved; whilst even the Emperor Maximilian sent to his cousin Philip a remonstrance, which, of course, was disregarded. Meanwhile, in the Netherlands, the position had become critical in the extreme, and William of Orange was convinced that the time for action really had come. Accordingly he declared himself a follower of Calvin, and set about to collect an army of German mercenaries, French Huguenots, and Flemish and Dutch exiles. In a word, the Revolt of the Netherlands was an accomplished fact.

Not much was achieved by William's rather motley crew of fighters, with the exception of the success gained by Louis of Nassau at Heiligerlee.

This reverse made Alva furious, and its immediate effect was the execution of Counts Egmont and Horn in the market place at Brussels. Both Counts were members of the Order of the Golden Fleece, and, as such, entitled to be tried by their own order. Their trials, therefore, were in every respect grossly illegal and flagrantly unfair.

Alva's Reign of Terror

Alva himself then marched against Louis of Nassau, and defeated him at Jemmingen, July 21, 1568. In the hope of revenge William led an army into Brabant. Alva, however, avoided an engagement, and the expedition proved a failure, William with his brother crossing over into France.

Considering the revolt crushed, Alva continued his reign of terror, adding extortion to cruelty. His troops were clamouring for pay, and, in order to raise the necessary money, he had recourse to all manner of harsh, exacting measures. The result was that thousands of the most industrious inhabitants of the country fled overseas. Trade and manufactures were transferred to England; and Antwerp, which in the time of Philip's father had been the first port in Europe, yielded precedence to London.

At last even Philip was convinced of Alva's incompetence, and decided to recall him. He remained on, however, till 1573, and in the meantime the revolt against Spanish domination spread.

In 1572 the "Beggars of the Sea" seized Brelle. These beggars were really exiles who made their living by piracy. Up to this time they had been given shelter on the English coast by Elizabeth. As a sop to Spain, however, the English Queen now ordered them to leave. This they did, and pounced upon the town at the mouth of the Meuse.

This act had a great effect upon the Netherlands. Most of the chief towns of Holland now declared for William of Orange; and the revolt became a matter of general European interest.

At the time of the capture of Brelle much was hoped for from France, the French Court being entirely under the influence of the Protestant Coligny. Elizabeth of England, moreover, greatly incensed with Philip, was considering a marriage with the French King's son, the Duke of Alençon, who was to be offered the sovereignty of the Netherlands. Then suddenly the massacre of St. Bartholomew, which occurred on August 24, 1576, dashed to the ground all that was hoped from the French alliance.

But William had already crossed the Rhine with the intention of raising the southern provinces and delivering his brother Louis in Mons. In the circumstances, Alva avoided a battle, and the Prince was forced to retire to the northern provinces, while Louis capitulated to Alva's son.

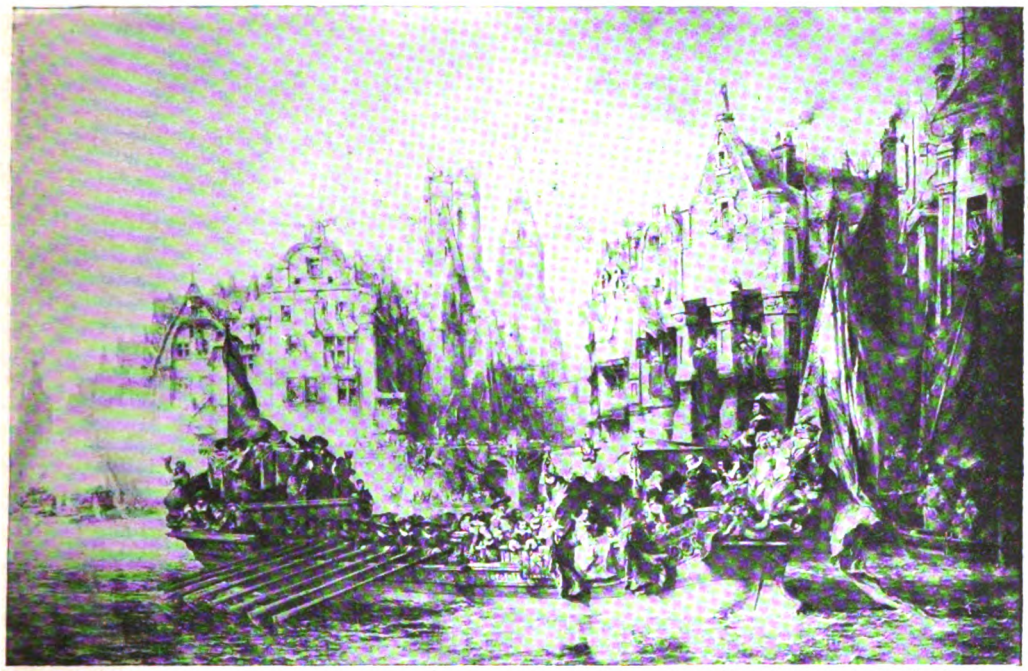
The fall of Mons was fatal to the hopes of William so far as the southern provinces were concerned. City after city returned to its allegiance to Spain. Alva was generally content with the taking of a new oath of allegiance. Malines, however, was ruthlessly sacked; and Zutphen and Zaarden were treated in much the same manner, Alva's orders being that not a man was to be left alive, and that all the houses were to be burnt to the ground.

The Sea Beggars

Alva was succeeded by Don Luis de Requesens, Grand Commander of Santiago, a moderately inclined man, who was anxious to undo some of the damage done to the Spanish cause by Alva's cruelty and oppression. But he could not accede to William's demands—the withdrawal of the Spanish troops; restoration of the old constitution; religious freedom. So the struggle went on.

In February, 1574, the Sea Beggars took Middelburg, and thus deprived Spain of the whole island of Walcheren. But in the south in the following April, the battle of Mookerheyde deprived William of his gallant brother Louis, who, with his brother Henry, was killed fighting valiantly.

Requesens, who considered that religion had very little to do with the rebellion, then offered a general amnesty to all who would return to the Catholic fold. But in the north political discontent and Protestantism



From the painting by Isabey in the Louvre.

The arrival at Rotterdam (1567) of the Duke of Alva, the notorious Regent whom Philip II. of Spain sent to practise "frightfulness" in the Netherlands.

From the painting by C. Verlet in the Antwerp Museum.

The statue of Alva being dragged by joyful citizens through the streets of Antwerp after the Duke's recall to Spain in 1573. Antwerp suffered terribly under oppressive foreign rule. During the "Spanish Fury" of 1576, 8,000 citizens were massacred and property to the value of £12,000,000 destroyed.

had become identical, and the offer was rejected.

After this an attempt was made to come to terms with William, and a conference was held at Breda to discuss the situation.

Requesens promised to dismiss the Spanish soldiery and to summon the Estates General, provided that the Prince in return would dismiss his foreign mercenaries and give up certain towns as hostages or guarantees in return for the security of the King's sign manual. The only concession offered to Protestants was that they should be allowed to leave the country with their effects. On such conditions peace was, of course, impossible ; and the negotiations were broken off in July, 1575.

Prior to the Conference of Breda an attempt had been made at conciliating the southern provinces, but here again the demands of the Estates as to the dismissal of the Spanish troops and exclusion of foreigners could not be complied with. Thus even in the south the total restoration of the King's sovereignty was not effected.

In June, 1575, the Prince of Orange received an important extension of his powers from the Estates of Holland and Zeeland, being entrusted with absolute powers in all matters concerning the defence of the country.

Pacification of Ghent

The next year, 1576, Requesens died suddenly, and an interregnum occurred in the Regency. This was signalised, among other things, by the "Spanish Fury," as it was called. On the fall of Zierickzee in Zeeland, the Spanish soldiery, rendered furious on account of their arrears of pay, deserted their leader and made for Brabant, seizing and plundering many of the wealthy cities. They began with Alost and ended with Antwerp, where no fewer than 8,000 people were massacred and property worth twelve million pounds destroyed.

But "there is a soul of goodness in things evil," it is said. The sack of Antwerp resulted in the famous Pacification of Ghent, which was signed in November, 1576, by delegates from all the provinces south as well as north. The most important clause of this agreement was that which provided for the expulsion of the Spaniards from the Netherlands. Further, it was agreed that the Prince of Orange should continue as Lieutenant, Admiral and General for the King for Holland and Zeeland, and that no decrees against heresy should be enforced without the authority of the Estates General; that no steps should be taken adverse to the Catholic religion outside the Provinces of Holland and Zeeland and that no deprivations of ecclesiastics should be made without compensation.

A day or two before the publication of this famous treaty and immediately before the sack of Antwerp, Don John of Austria, Philip's half-brother, crossed from France into Luxembourg as the new Governor of the Netherlands. Philip seems to have discovered that he could not coerce William of Orange or satisfy the people of the Netherlands without concessions. Don John, therefore, was sent over for the purpose of conciliating the refractory people.

A charming and popular young man, partly spoilt by good fortune and flattery, Don John had developed many ambitious schemes, of which one was to invade England from Flanders, and marry either Mary Queen of Scots or Elizabeth.

But a difficulty at once arose ; the first demand made by the Estates General was as usual that the Spanish troops should depart.

This, in the circumstances, he was willing enough to grant, but he stipulated that they should go by sea, and that ships should be provided for the purpose. The Estates, however, though they knew nothing of his project of invading England, and suspecting some sinister motive, would not consent. Don John, therefore, was forced to give up his great idea.

The other demands made by the Estates were that all prisoners should be released and that all charters should be confirmed, and the Estates General should be convened as they were in the time of the Emperor.

The Perpetual Edict

These were conceded, and Don John signed the "Perpetual Edict" to this effect in February, 1577. In May he entered Brussels, where he received a warm welcome, and it looked as if his policy of conciliation would succeed.

But there were serious obstacles in the way. Neither Philip nor William entirely trusted Don John. Both, moreover, were a trifle jealous of him. William suspected Don John—and with good reason—of complicity in plots to assassinate him. Philip suspected his brother of a design on the crown of Spain.

In these circumstances, when William entered Brussels after an absence of many years, it looked once more as if the north and south provinces would go together and be lost to Spain. But at that time, as now, the inhabitants of the north and south held

different religious beliefs; and the Catholic nobles of the south were no more enamoured of the democratic ideas than of the religion of the people of the north. Accordingly they agreed amongst themselves to appoint the Archduke Matthias of Austria as Governor General, subject to the approval of Philip.

This brought matters to a head. Forthwith Philip sent back the Spanish troops, with the result that Don John and his former Regent, an exceedingly capable statesman and energetic and brave soldier. The new Governor at once took advantage of the religious animosities which, for some years past, had been on the increase between the Calvinists of the north and the Catholics of the south. He saw that in this direction alone lay the possibility of restoring the whole of the seventeen provinces to its allegiance.

William, who had been brought up a Catholic, was distrusted by the extreme

From the painting by L. Gallait in the Antwerp Museum.

The Guild Marksmen of Brussels paying the last honour to the heroic Counts Egmont and Horn who in 1568 fell victims to the savagery of Alva.

nephew Alexander of Parma were able to defeat the Archduke and William.

The Catholics then turned to Francis, Duke of Anjou, brother of the French King, a worthless libertine, who came to Mons to escape from his difficulties in France, his position in the French Court having become untenable. His candidature, however, was not seriously considered until some years later, for in the midst of the negotiations Don John died at the age of thirty-one, worn out with disease and disappointment over the apparent failure of his plans. None the less, he had at any rate succeeded in preparing the way for the return of the southern provinces to the allegiance of Spain.

Don John was succeeded by his nephew, Alexander of Parma, son of Margaret the Calvinists as much as by the bigoted Catholics, and this fact his astute and clever adversary exploited to the full. Already the Walloon Provinces of the south and east had reverted *en masse* to Catholicism; and in consequence of this and Parma's policy William's scheme of a united Netherlands practically received its death blow.

In 1579 was formed the Catholic League of Arras, which aspired to bring about reconciliation with Spain. To this the Protestants replied with the Union of Utrecht. Thus was the breach further widened; and still more was this the case when the "Malcontents," the name given to the Catholic irreconcilables, made a new treaty with Philip to the effect that in the Walloon Provinces only the Catholic worship would

be permitted. Things were going from bad to worse for the "rebels." Only in Holland and Zeeland was William's authority secure.

At this juncture he received aid from an unexpected quarter.

A ban was promulgated against him, in which the King denounced him as a traitor and a miscreant. Many crimes were recited against him, while a reward of 25,000 crowns in gold and a patent of nobility were offered to any one who would rid the world of this pest or produce him dead or alive.

The ban came at a time very opportune for William, whose followers were accusing him of lukewarmness, and criticising the support which he had been giving to the candidature of Anjou.

The effect of the ban was at once to relieve him from the suspicion of his Protestant followers. He was also afforded an opportunity to explain his position in an *Apologia*.

In this document William gave a sketch of his whole career, rebutted the charges made against himself, accused his enemies of having committed most of the crimes in the moral calendar, and, after scoffing at the rewards which had been offered for his assassination, concluded with a passionate appeal to his people.

Henceforth the position of William as well as that of his country was assured. William was again pressed by Holland and Zeeland to become their Count in lieu of Philip.

Queen Elizabeth's Interference

This honour he had previously declined, being desirous not to offend the southern provinces. The sovereignty of the United Netherlands had meanwhile been offered to the Duke of Anjou on certain conditions, and now in July, 1581, William, as Count of the two Protestant Provinces, joined in a solemn act of abjuration by which the representatives of Brabant, Flanders, Utrecht, Guelderland, Holland and Zeeland declared the deposition of Philip.

Next year Anjou came over from England with a large retinue and letter of recommendation from Queen Elizabeth, and it was on the occasion of the festivities in connection with the Duke's inauguration in Antwerp, that a dastardly attempt was made on William's life.

The Prince miraculously recovered of his wound, and was able for a few more years to serve his country. Meanwhile, however, Anjou concocted a villainous plan to get rid of him, and at the same time to restore the Catholic religion.

This plot, by which several cities—Antwerp among them—were to be seized, came to be known as the "French Fury."

The attack on Antwerp failed dismally, the French being hopelessly worsted by the brave Flemings. This failure made Anjou's position impossible, and it is difficult to understand how William could have brought himself, in the circumstances, to continue his support of French interests. One can only assume that he saw that, at the time, the provinces were not strong enough to stand alone.

In the meantime, his by no means unworthy adversary, Alexander Farnese, had been making much headway, even in the north, and had got possession of Zutphen and the district of Maes. Gradually he had drawn to himself the Catholic nobles; and even William's own brother-in-law was among those who could not resist the attraction of the fascinating Spaniard. But William still held to his French project.

Independent Netherlands

On the 10th July, 1584, William was assassinated by one Bathasar Gérard, a devoted follower of the Spanish King. The "Father of his Country" was only fifty-one years old at the time of his death.

As William the Silent he has come down to history, and to him undoubtedly is due the independence of Holland. Had his spirit of toleration only been present in his followers, moreover, it is safe to say that the Netherlands would not have been divided.

William left two sons, Maurice, the famous soldier, and William Henry. Both were worthy descendants of an illustrious man.

It was upon Maurice that William's authority descended; and he soon began to display those soldierly qualities which later made him famous as a commander. But there was no stopping the prowess of Alexander of Parma. Before the end of the century he had reduced the whole of the southern provinces to obedience, and in 1595 Philip was in a position to hand them over as the Austrian Netherlands to his daughter Isabella on her marriage to the Archduke Albert.

The northern states, however, maintained their independence; and after the death of Alexander Farnese, the Netherlands, to all intents and purposes, acquired independence. Spain never formally relinquished her sovereignty, but so far as the seven provinces were concerned, tacitly abandoned her pretensions by the twelve-year truce granted by Philip III. in 1609. F. C.

Continued from page 149.

SCIENCES:

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SOUND.—V

16. Resonance.—As we have seen, a string has a natural period of vibration, giving out a certain definite note which can be calculated when its size and weight, and the tension on it, are known. Now, if a string is tuned up to a particular note—say, C—and that note is sung or sounded in the neighbourhood of the string, it will be found that the string responds to this note and commences vibrating in sympathy with it. This is an example of *resonance*, and does not occur if another note — say, G—is sung instead of C. The same effect can be heard on a piano, especially if the pedal be kept down. We also hear wine-glasses, etc., start to sing when the note which they can themselves emit is sounded in their vicinity.

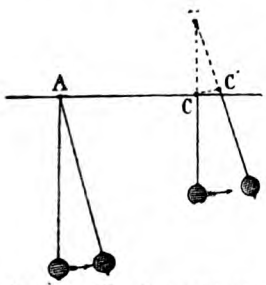


Fig. 38a.–To demonstrate the principle of Forced Vibrations.

The fact can be simply studied and explained in the case of a simple pendulum Suppose two simple pendulums, A and B, of equal lengths, are suspended from an india-rubber cord drawn tightly across the room. Let one of them, A, be set into vibration; very soon the other will be vibrating vigorously in tune with it. The vibration of A sends a periodic disturbance through the support to B. This causes B to vibrate, and as the disturbance reaches B periodically and in tune with its own natural swing, that swing is constantly reinforced; its amplitude increases for the same reason as that of a swing boat does when an impulse is given it at periodic intervals equal to the time of the swing.

But if a third pendulum, C, of different length and period, is hung to the same support, it does not take up the vibrations in the same way. The periodic impulses do not act on it always at the same phase of its swing, hence they tend now to destroy, now to enhance, its motion. The result is that C is irregularly shaken—stopping and moving apparently under no law. Nevertheless, after a time, it will be seen to be trying, as it were, to adapt itself to A and B; and will in the end vibrate in the same period as they. These are *forced vibrations*. A body, whose natural period of vibration is t, is forced to adapt itself to another period t', when the body as a whole, with its support, is moving in that period. The action of a sounding-board depends on this principle. The note given by a string is communicated to the board through its supports; the board responds by forced vibrations in unison; and these, by disturbing a greater amount of air, greatly intensify the sound. If the sounding-board is in unison with the note, as is the case with the resonance-box of a tuning-fork, the reinforcement is even greater. Resonance is indeed only a special case of forced vibration, in which $t = t'$.

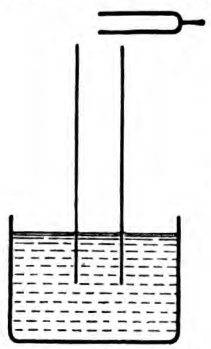


Fig. 39.—To make air enclosed in a pipe give its own characteristic noise.

The air enclosed in a pipe or vase or any other cavity can be thrown into vibration, and gives its own characteristic note dependent on the size of the pipe in a way we shall presently examine. Thus, if a wide glass tube about 16 inches long, open at

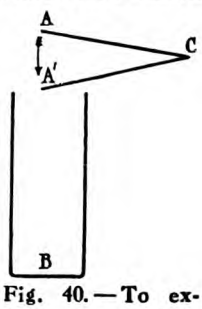


Fig. 40.—To explain the curious sound of the voice in a cave.

both ends, be placed in water (Fig. 39), and a tuning-fork emitting the note C=256 be held just above its mouth, the sound of the fork can be heard faintly—the air being thrown into forced vibrations in tune with it. Now push the tube farther into the water; it will be found that, when the length of the air column in the tube is about 13 inches, a loud resonance is heard, showing that at this depth the column of air is in tune with the vibration frequency of 256. Using the fork G=384, we should find the depth of the column of air to be about 9 inches; and so on, in direct proportion for other notes. This resonant power of air chambers is exceedingly important in music. The very action of many instruments depends upon it, and the acoustic properties of many rooms are modified by it also. The note of the human voice would be a very different affair, both in intensity and in quality, if it were not for the resonating properties of the pharynx, mouth and nasal chambers. The curious sound of the voice in a cave is partly due to the effect of resonance in enhancing the value of some of the overtones, and not others.

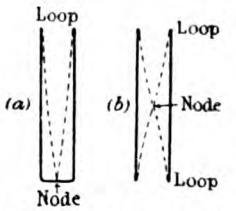


Fig. 41.—Loops and nodes as applied to organ pipes.

We must inquire more particularly why the resonance takes place at a particular depth (Fig. 40). Suppose A and A′ to be the extreme positions of the prong A C of a tuning-fork, vibrating over a closed jar which is resounding to it. In moving from A to A′, a compression is driven down the tube, is reflected by the fixed end B, and returns to the top again as a compression. On reaching the top the air becomes free; it will expand; and, since it was compressed, will over-expand and form a rarefaction. If at this instant the fork is beginning to perform its journey back from A′ to A, it also will be producing a rarefaction. Thus, there will be a double rarefaction: that due to the returning compression being added to that being produced by the fork. And it will be seen that the condition for this coincidence is that, while the fork is moving through A A′, the compression formed should travel down and up the tube, and be just arriving at A′ when the fork is there. Hence the journey down and up the tube corresponds to half a vibration of the fork, and is equal to half the wave-length of the wave produced. Therefore the wave-length of the note given is clearly equal to four times the depth of the tube.

If the velocity of sound be taken as 1,120 feet per second, the wave-length of the note C (= 256) is $\frac{1120}{256} = 4{\cdot}3$ feet, and the depth of a closed tube giving perfect resonance is $\frac{1}{4} \times \frac{1120}{256} = 1{\cdot}1$ feet approx.

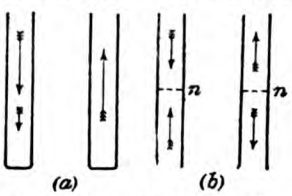


Fig. 42.—Showing the motion of air in an organ pipe.

Such a resonance tube can be used to find the pitch of a given note, or if the pitch is known it gives us a value for the velocity of sound in the air in the pipe. A certain small allowance has to be made in accurate experiments for the width of the tube. Find the depth at which the loudest resonance is given; then add three-fifths of the radius as an allowance for the width of the tube; and the result is $\frac{1}{4}l$, where l = the wave-length of the note.

When the tube is open at B, i.e. open at both ends, the resounding length is $\frac{1}{2}l$, not $\frac{1}{4}l$. For a compression sent down the tube suddenly becomes free at B, and a rarefaction is formed, which travels back up the tube. Thus a compression does not return to A′ as a compression, but as a rarefaction. This rarefaction, on reaching A′, sets up a compression there, as it were by suction; in order to give resonance this compression must begin when the fork is at A and is about to move forward to A′. In other words, the fork makes a complete vibration while the compression travels down the tube and up again (as a rarefaction). In this case the wave-length is equal to twice the length of the tube.

17. Organ-Pipes.—Our previous discussion has shown us that the column of air in a pipe has a definite period of vibration dependent on its length, and in a small degree on its width. If d=length of pipe and v the velocity of sound in air, the frequency of the note producible from the pipe will be $\frac{v}{4d}$ or $\frac{v}{2d}$, according as the pipe is closed at one end or open at both ends. It is convenient to think of the vibrating air in the language of vibrating strings, and speak of the places of rest as nodes and the places of greatest motion as antinodes or loops. It is therefore clear that the open ends will be loops, inasmuch as they are the places where the air particles are most disturbed and have the widest amplitude. It is also evident that the closed end will be a node, where there will be the greatest change of pressure but the least motion; and as there is a loop at each end of an open tube, there must be at least one node between them. We thus get Fig. 41, which shows these matters diagrammatically. In Fig. 42 we represent the motion of the air.

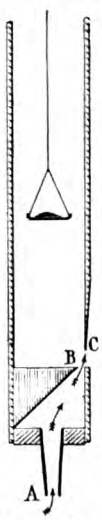


Fig. 43.—The principle of the organ pipe.

It may not at first be easy to see how a node can arise at the middle of an open tube. But the condition there is that of what are called *stationary waves*. In reality two sets of waves are travelling down the tube: the direct set from the fork, and the reflected set from the bottom of the tube. If the fork and the tube are in harmony, a compression will be starting at the top exactly at the same instant as a return compression will be starting from the bottom. A particle midway between the two ends will be equally propelled by these

compressions in opposite directions, i.e. will not move. The same argument applies to the rarefactions; consequently the node is a stationary point throughout, though, as our explanation requires, it is subject to the extremest variations of pressure. Such a train of waves in which the nodes and loops are at fixed points is *stationary*. The waves on a vibrating string are also of this type.

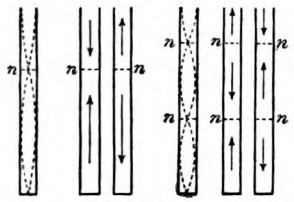


Fig. 44.

An organ-pipe is the most convenient instrument for further study of the vibration of air in pipes, and we may briefly describe it here. It may be of metal or of wood, round or square, open or closed; in either case the sound is produced by the vibration of a column of air, as in the cases of resonance just described. The air is directed from the bellows through A and through the narrow slit-like orifice at B on to the sharp edge of metal C (Fig. 43). How the first waves are set up cannot with certainty be stated; but probably the stream of air is not directed perfectly symmetrically on to C, being either diverted to the right or to the left a little. If it is diverted to the right a rarefaction is caused; if to the left a compression. The vibration is then maintained as in the case of resonance; a returning compression becomes a rarefaction without the necessary assistance of the current of air, and vice versa. Certain difficulties remain in this explanation: notably we cannot explain clearly why the note rises in pitch when the velocity of the stream of air is increased. In practice, the closed end of an organ-pipe is a movable piston, by the adjustment of which the pipe may be tuned; with open pipes the tuning is usually effected by altering the size of the open aperture at the upper end, the pitch of the pipe being raised.

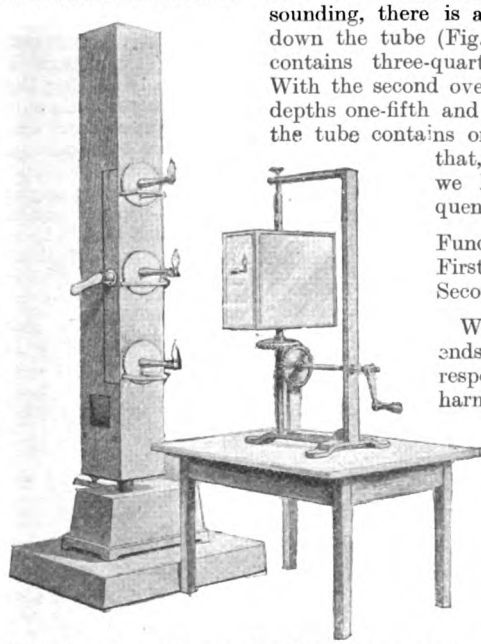


Fig. 45.—Koenig's capsules fitted into an organ pipe, with revolving mirror for showing flame motions.

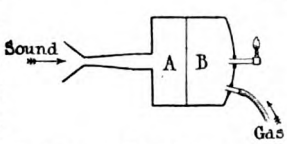


Fig. 46.—Koenig's manometric capsule.

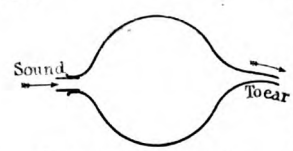


Fig. 47.—Helmholtz resonator.

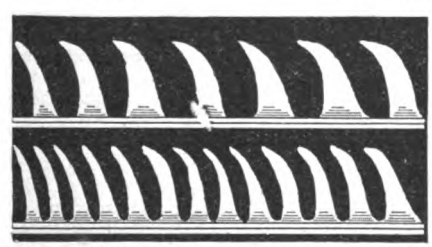


Fig. 48.—The image of a note and its octave shown by the reflections of a flame on the revolving mirror (*see Fig. 45*).

Overtones may be produced in both classes of pipe, but not the same in both. The overtones are true harmonics having frequencies which are simple multiples of that of the fundamental. The first overtone in the closed pipe is the second harmonic, and has a frequency three times that of the fundamental; in general the series of overtones is the odd series of harmonics with frequencies 1 : 3 : 5 : 7 : etc. When the first overtone is sounding, there is a node one-third the distance down the tube (Fig. 44), so that the whole tube contains three-quarters of a stationary wave. With the second overtone, there are two nodes at depths one-fifth and three-fifths respectively, and the tube contains one and a quarter waves. So that, if d = the depth of the tube, we have for the successive frequencies and wave lengths:—

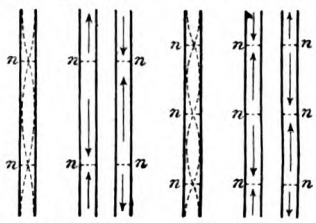


Fig. 49. Fig. 50.

Fundamental ..	n	..	$4d=l$.
First Overtone ..	$3n$	..	$\frac{4}{3}d=\frac{1}{3}l$.
Second Overtone	$5n$	..	$\frac{4}{5}d=\frac{1}{5}l$.

With the pipe open at both ends, overtones are produced corresponding to all the possible harmonics. In the first overtone we have two nodes, each one-quarter the length of the tube from an end; the tube will then contain one complete wave (Fig. 49). There are three nodes for the second overtone, one at the middle and the others at one-sixth the length of the tube from the ends. Fig. 50 shows that there are now one and a half waves in the tube. Generally, when there are x nodes, we are dealing with the $(x-1)$th overtone, with frequency x times the fundamental. In tabular form, we may express it for the fundamental and the first three overtones thus:—

Number of Nodes ..	1	2	3	4
Wave-length	$2d$	d	$\frac{2}{3}d$	$\frac{d}{2}$
Pitch ..	n	$2n$	$3n$	$4n$

The overtones are in general more or less mixed with the fundamental, the mixture being responsible for the difference in quality of the notes produced by instruments of the pipe class. But they can

be produced in greater intensity and free of the fundamental by using a more rapid or more violent blast. Their presence may be indicated by lowering into the pipe a little parchment tray on which a little sand has been sprinkled. At the nodes the sand remains still, but elsewhere it dances about, most violently at the loops midway between the nodes.

A more delicate explorer of a pipe is *Koenig's manometric capsule* (Fig. 46), which can be fitted into an organ pipe at various places (Fig. 45). The principle of this dainty little instrument is a vibratory membrane dividing the whole into two chambers A and B. A is connected to the pipe which is being examined; B has two openings—one leading to a pinhole gas-burner, the other for the admission of the gas. If there is a change of pressure in A, it will affect the gas in B through the membrane, and hence modify the flame at the burner. If, for instance, A is connected with an organ pipe at a node, there will be rapid alternations of pressure, and the flame will rise and fall in harmony with these. The rise and fall can be observed by rotating a four-sided mirror before the flame. The image of the flame is then wavy, instead of a continuous streak of unbroken light (Fig. 48).

For detecting the overtones in a complex note, a manometric capsule is connected to a Helmholtz resonator, tuned to a known note. The resonator is a spherical metal vessel (Fig. 47), which picks out, as it were, its own particular sound, and even when it is faint announces it in the manometric flame. E. W. E.

ELECTRICITY AND MAGNETISM.—XVI

PROBABLY the most widely known electrical apparatus, the working of which is essentially of an electrolytic kind, is the accumulator, but before we can understand its mode of working we must perform experiments connected with the electrolysis of acid solutions.

Experiment 50.—*To electrolyse dilute sulphuric acid.*

Pour a little fresh dilute sulphuric acid solution into a small glass vessel, such as an old wine glass. The proportion of ten parts of water to one part

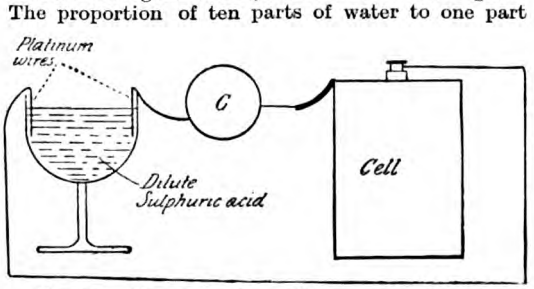


Fig. 55.—To electrolyse dilute sulphuric acid.

of acid will be suitable. Now attach your two small lengths of platinum wire to ordinary conducting wires connected with the terminals of a single dry or other cell. The free ends of platinum wire should be bent over the rim of the glass, and immersed in the solution. An astatic galvanometer should be included in the circuit. When both platinum wires are immersed the galvanometer needle will move if a current is flowing. Should this be the case note what happens near the platinum wires in the dilute sulphuric acid.

It is possible that no current will flow if only one cell is used, and should this be the case connect in series another dry cell with the first one and note the bubbles of gas escaping from the solution near the wires.

Experiment 51.—*To collect the gas bubbles appearing at the electrodes.*

If possible obtain two small glass test tubes from a chemist. Such tubes are quite inexpensive and are useful for other experiments. In a piece of thick cardboard, the length of which is a little greater than the diameter of a small earthenware basin, cut out two circular holes of such a size that a test tube just fits fairly tight in each. Now we have to fit up the apparatus as shown in Fig. 56, the acid solution occupying the tubes as well as the basin. Put enough dilute sulphuric acid into the basin as will occupy about one-third of the space, and add water until the basin is about two-thirds full. The solution will now be sufficiently diluted to allow one to place his fingers into it without any serious results, though hands that have been immersed in any acid should be rinsed under a tap afterwards. Immerse one of the test tubes so that the air is driven out and the tube completely filled with the liquid.

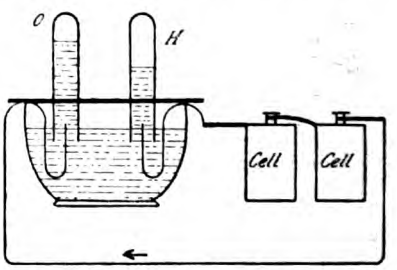


Fig. 56.—To collect the gas bubbles appearing at the electrodes.

Do the same thing with the other tube. Next lift the tubes into an upright position in such a way that their open ends are beneath the surface of the liquid. Hold the tubes upright and get someone to adjust the cardboard so that the tubes protrude through the holes, yet keep their open ends under the solution. The cardboard when properly adjusted will form a support for the glass tubes. All that remains to be done is to arrange the platinum wires with a free end of one in each of the tubes and the other ends connected with the terminals of two cells joined in series if the E.M.F. of one cell is insufficient to send a current through the solution. Allow the current to flow for some time and note the collection of gas in each tube. Does an equal volume of gas collect in each tube? If not, at which electrode does the greater volume of gas collect?

It will be noticed that the platinum wires do not become plated with any substance or altered in any other way. Obviously the ions resulting from this electrolysis consist of gaseous substances that collect in the tube, and about *twice the amount of gas collects at the kathode as does at the anode.* What are these gases? The gases in the tubes must be hydrogen or oxygen or both.

There is a simple chemical test by which we may distinguish these two gases. Hydrogen burns oxygen does not, though it enables other substances to burn.

Experiment 52.—*To determine which gas, hydrogen or oxygen, appears at the kathode and anode respectively.*

Allow the current to flow through the apparatus until the tube containing the greater amount of gas is nearly full. Place your thumb over the open end of this tube and carefully withdraw it from the hole in the cardboard. Strike a match, remove your thumb, and bring the light to the open mouth of the tube. A slight explosion occurs and the gas burns with a feeble blue flame. The gas was hydrogen and collected at the kathode. Similarly remove the other tube without removing your thumb, turn it mouth upwards. Now remove your thumb and plunge a glowing splinter into the gas. The splinter bursts into flame. The gas you collected at the anode was oxygen.

We are now in a position to summarise the results of the three experiments. *Whenever dilute sulphuric acid is electrolysed, the ions liberated are*

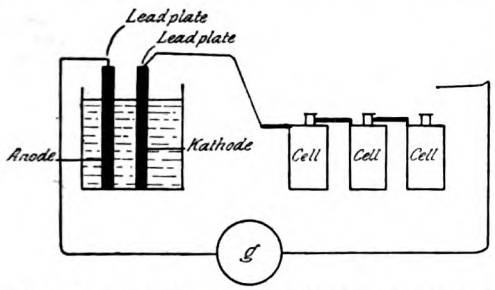


Fig. 57.—To determine which gas, hydrogen or oxygen, appears at the kathode and anode respectively.

hydrogen and oxygen, the former appearing at the kathode and in about twice the volume of the oxygen appearing at the anode. These gases obtained by electrolysis do not react chemically with the platinum wires, but they do perform electro-chemical changes with other substances, such as lead, as we shall see in a later experiment.

Experiment 53.—*To show what a definite minimum voltage is required for the electrolysis of dilute sulphuric acid.*

Use the same apparatus as in the previous experiment with the exception of the dry cells. In their place use a simple zinc and copper cell. Observe whether the galvanometer indicates a flow of current or not.

The E.M.F. of a simple cell at its best is about one volt, and this is found to be insufficient to accomplish the electrolysis of the solution.

It is evident that the acid solution offers something more than mere resistance to the passage of electricity through it. If the solution acted as a conductor having a high resistance, a feeble current would flow in accordance with Ohm's law, and the galvanometer would indicate the presence of a current. We must endeavour to discover what this additional obstacle to the passage of electricity through the acid solution is. Suppose we perform another electrolysis of dilute sulphuric acid using electrodes composed of sheet lead instead of platinum wire.

Experiment 54.—*To investigate the principle of the accumulator.*

Arrange a circuit consisting of three or four cells connected in series, a galvanometer, a trough containing dilute sulphuric acid and electrodes composed of flat lead plates, and the necessary connecting wires. Leave a break in the circuit; this may be most conveniently situated at the positive terminal of the battery. Complete the circuit, note the direction in which the galvanometer needle moves, and allow the current to flow for some time, say a quarter of an hour. Observe the formation of a brown deposit on one of the lead plates. On which plate is it formed? Remove the battery altogether and complete the circuit, observing the behaviour of the galvanometer as you do so. *A current flows along the circuit in a direction opposite to that of the previous current from the battery.*

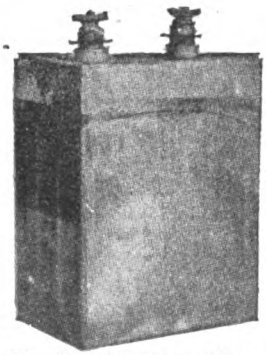


Fig. 58.—An Accumulator.

The lead plates after electrolysis have in virtue of the chemical charges performed an electromotive force which sends a current along a closed circuit when the battery performing the electrolysis is removed. *During the electrolysis there is a*

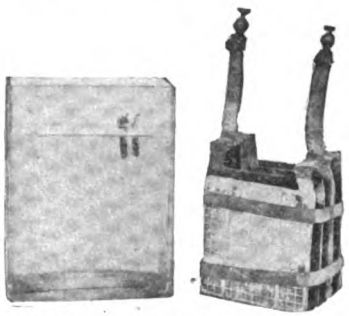


Fig. 59.—Parts of an Accumulator, showing the case and lead plates.

tendency in the electrolytic cell to send a current in opposition to that performing the electrolysis, and consequently the E.M.F. of the lead plates is called a Back E.M.F. Now we see why one cell was insufficient to send a current through the solution. Its E.M.F. was lower than the Back E.M.F.

Accumulators are pieces of apparatus based upon the principle illustrated in our experiment. Specially prepared lead plates coated with oxide of lead to enable the essential electrochemical changes to take place easily are immersed in a weak solution of sulphuric acid. The plates are separated

from each other by some insulating material such as celluloid, and the whole is contained in an outer case made of celluloid or vulcanite (Fig. 59).

To charge an accumulator, a current from a dynamo or several cells is sent through it when the plate becomes altered chemically by the hydrogen and oxygen ions. These chemical changes are of such a nature that a student who has no knowledge of chemistry might have difficulty in following a full explanation of them, hence it will be sufficient to state here that the changing process reduces the anode to the condition of metallic lead, while the kathode plate becomes oxidised to lead peroxide.

After the accumulator has been charged and a current is being obtained from it, both plates become coated with a substance called lead sulphate. The anode of an accumulator is marked with a red cross, and the charging current must always be sent *into* the apparatus by the terminal so marked.

When the accumulator is being used as a source of current, the marked terminal will be the positive plate of the apparatus.

One or two hints may be of value. Never keep an accumulator in an uncharged condition. As soon as the voltage of each pair of plates falls as low as 1·8 volts the apparatus should be recharged.

Laws of Electrolysis

Similarly, do not put aside for a long time an accumulator in the charged state, as the "charge" will slowly dissipate itself. The terminals should never be connected by a conductor of low resistance such as a short wire. Such a "short circuit," as it is called, is liable to damage the plates.

The superiority of accumulators over ordinary "primary" cells, such as the Leclanché or Dichromate, lies in their more constant voltage, low internal resistance, good current, greater portability, and capacity of being repeatedly recharged without renewal of chemicals and plates.

Accumulators are often called "secondary cells," since the current obtained from them is the result of "secondary" chemical changes connected with electrolysis, whereas in ordinary cells the chemical actions are "primary" and not connected with electrolytic action.

The actual weight of an ion—copper, silver, hydrogen, etc.—deposited at an electrode is determined by three factors:—(1) The time the current flows. With a given current twice as much copper, for instance, will be deposited in ten minutes as would be deposited in five minutes by the same current. (2) The current strength in amperes. Two amperes will deposit twice the weight of copper, silver or hydrogen, as the case may be, that one ampere will deposit in the same time. (3) A certain numerical value known as the electro-chemical-equivalent of the ion. Space forbids a consideration of calculations based upon these fundamental laws.

The definition of the *Board of Trade Standard Ampere* is "that constant current which when passed through a solution of silver nitrate in water deposits silver at the rate of 0·001118 gram. per second."

L. M. P.

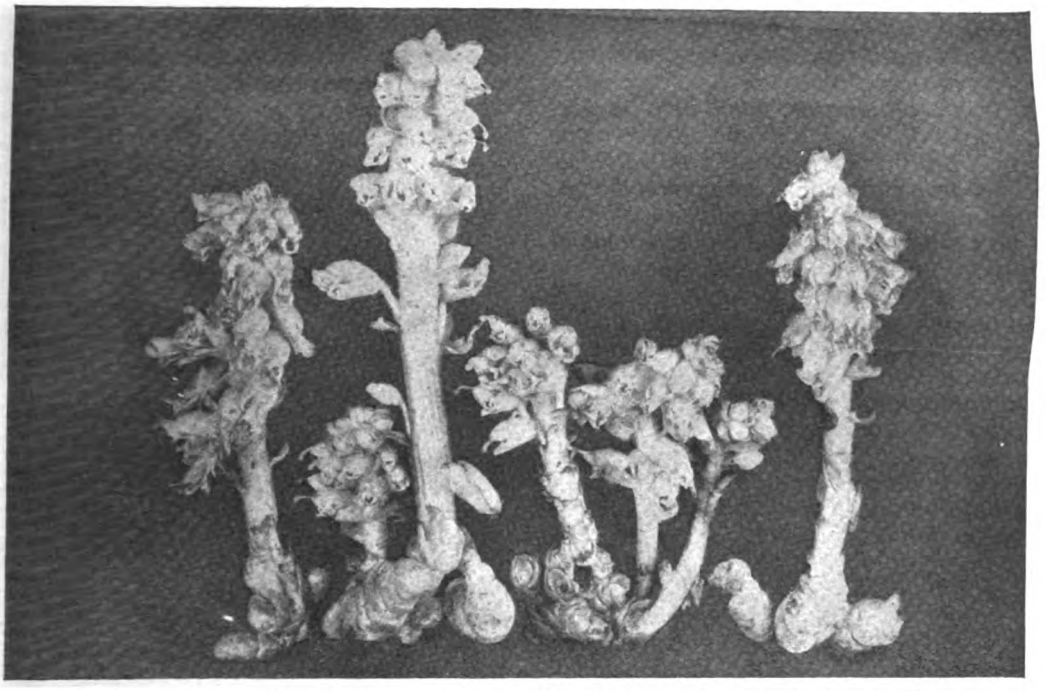
BOTANY.—IX

25. Parasites.—THE process of photo-synthesis is the first step in plant nutrition, and is, of course, peculiar to plants. There are in our flora, however, a few plants which have no green leaves: these must draw their sugar at least from other sources. Some of them are found to be dependent upon other plants for their nutrition; these are known as *parasites*. Others are able to satisfy their needs from the dead organic matter contained in humus; such plants are described as *saprophytes*.

As an example of a true parasitic plant, we may take the *toothwort*, which is found fairly commonly in damp woods, generally in association with the hazel or elm. Above ground the plant consists of an erect axis, several inches long, closely packed with dirty-looking purplish flowers, among which a number of much reduced scaly leaves can be observed. There are no green structures whatever. Underground there is a trailing horizontal stem which is much branched and bears an abundance of fleshy scales, as well as adventitious roots which, by means of expanded suckers, attach themselves to the roots of the hazel or elm, and through which the nutrient liquids of the host-plant pass into the parasite. The yellowish appearance of the plant makes it a fairly conspicuous object among the flora of shady woods. Very closely allied to it, but much rarer, are the *broom-rapes* found on broom, gorse, clover, etc.

In the *dodder*, which is also found on clover, gorse, etc., the parasitic habit is still more pronounced in its effect. The stem is reduced to a long and slender reddish thread which twines round the host and gives off suckers into its stem at the points of contact. The leaves are so minute as to be missed if not carefully looked for; and the only conspicuous parts of the plant are the bunches of pink flowers. Like the toothwort, only more emphatically, the dodder devotes the best part of its energy to seed-production; and this is necessary, since it is confined to a very restricted choice of "hosts." Unless the developing seedling strikes a suitable support, it will soon wither and die; if the plumule in the course of its growth does strike the stem of clover or heather, all is well: the radical dies, and the mature plant lives entirely on its host—even destroying it sometimes, as can be seen in clover fields which are infected with it.

Some common plants, though possessing green leaves, are partially parasitic in habit.



Toothwort, a true parasitic plant, commonly found in damp woods, generally in association with the hazel or elm.

Photos : S. Leonard Bastin.

Dodder which is found on clover, gorse, etc., twines round the host and gives off suckers into the stem at the points of contact.

PARASITIC PLANTS

The *yellow rattle* (*see* p. 206) and *eyebright*, common in meadows, are examples of this. Their roots grow into intimate connection with those of grasses, and thus depend mainly upon their neighbours for their water-supply. Another example is the *red Bartsia*, common on downs and open ground, and having a superficial resemblance to heather. Its roots attach themselves to those of grasses by means of flat suckers.

The *mistletoe* sends long suckers into the wood of apple, oak, hawthorn, etc.; but has green leaves, and is therefore only a partial parasite.

Saprophytes are even rarer among flowering plants than parasites. The only fairly common one is the *bird's nest orchis*, which is found in damp woods, especially in the shade of the beech. Above ground it shows a single erect stem at the base of which

Photo: Henry Irving.

Broom: showing immature seed pods.

are a few scaly leaves and at the top a number of dirty-looking brownish flowers. The underground portion consists of a nest-like arrangement of interwoven branches, and is not in organic contact with any of the neighbouring plants. It lives entirely on the humus of the soil in which it grows.

The most common saprophytes are, however, not flowering plants at all, but members of the vast family of *Fungi*. The common mushroom is an example of a saprophyte which lives on humus, and the affection of moulds for jam and other media containing sugar is well known. Both mushrooms and moulds show in an extreme degree the nemesis of the parasitic habit. The actual plant is in each case reduced to a long, branched, thread-like *mycelium*, which is confined to the organic substratum. From

Photo: Henry Irving.

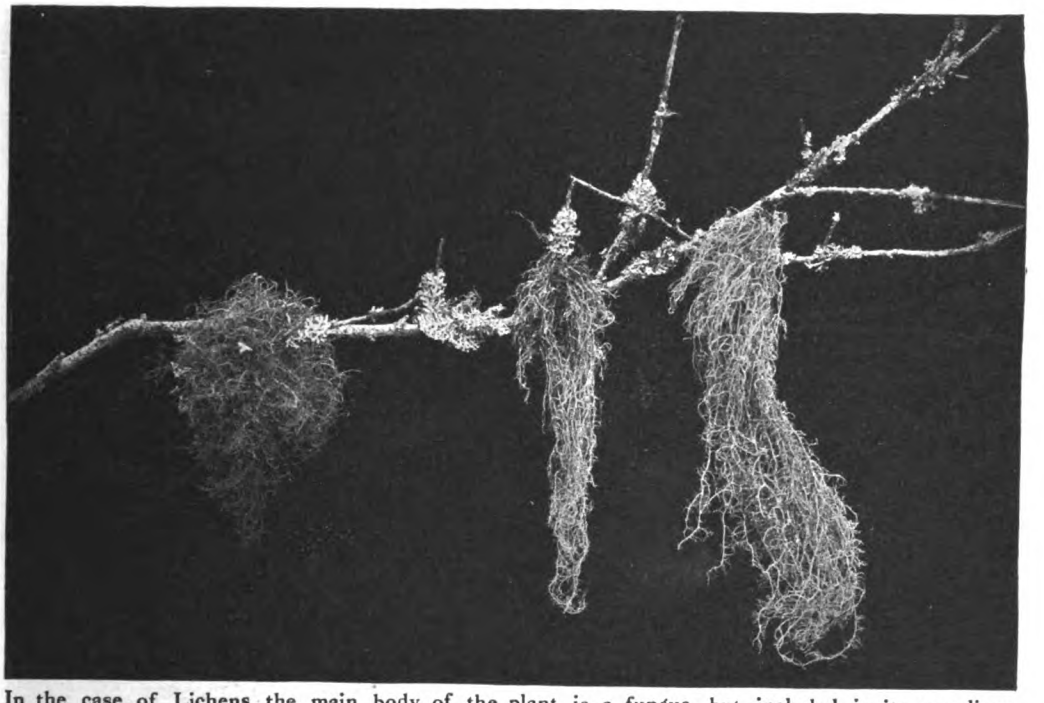
Broom in flower: three of the flowers seen above have exploded.

this grow the *fructifications*, which are the only visible parts, and are devoted entirely to the production of innumerable spores.

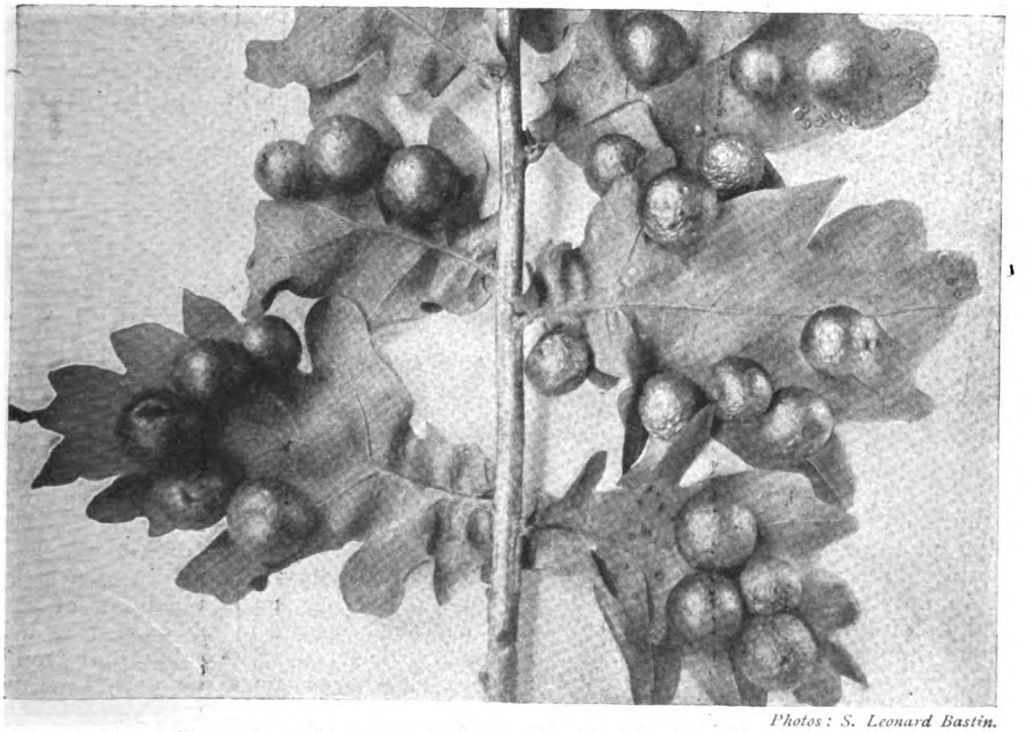
Many fungi are also true parasites; smut, rust, mildew, ergot, are examples of diseases set up in well-known agricultural plants by true parasitic fungi. The destructive effect of such fungi is seen on a large scale in the ravages of the potato blight; it may be illustrated in a smaller way in the case of the "damping off" of cress seedlings, when they are sown too thickly together.

DEMONSTRATION XXIV

Sow some mustard seeds thickly in very damp soil in a flower-pot, cover the pot with a sheet of glass, and put it away in the dark. Notice carefully the condition of the seedlings day by day. After about the third day it will usually be noticed that there is a thin, filmy covering developed at the base of the stems near the soil. This is the mycelium of a fungus known as *Pythium*. As it grows into the tissues of the plant, the mycelium makes the stem



In the case of Lichens the main body of the plant is a fungus, but included in its mycelium species of *Algæ* are found.



Photos: S. Leonard Bastin.

The familiar galls on the oak are abnormal growths caused by the action of insect parasites.

PARTIAL PARASITES

weaker and weaker until it can no longer support the plant; in a week or ten days the seedlings will have become a rotting mass of vegetation.

The most important group of fungi is the *Bacteria*, some of which are parasites and some saprophytes. They are exceedingly simple organisms, and can only be studied under high microscopic power. But they tend to develop in colonies which can be rendered visible to the naked eye.

DEMONSTRATION XXV

Cover a glass plate with a thin film of dilute gelatine (as in a photographic plate) and leave it exposed to the air. In a few days small white patches will appear. These are bacteria colonies.

By using sterilised plates, i.e. plates which have been well boiled to destroy any bacteria on them, we can examine the development of bacteria from any source. Soil water is found to be rich in them, and they are found to develop rapidly in almost any organic liquid exposed to the air. Special forms are responsible for cholera, diphtheria, and many other diseases; they live generally as saprophytes, producing substances (toxins) which act as violent poisons. As we saw in the case of the soil, however, their activity is not always injurious. The process of nitrification is entirely dependent upon them.

YELLOW RATTLE
is a good example of a plant with green leaves, but partially parasitic in habit.

In one particular case they have an interest for us here. The roots of many members of the family Leguminosæ (e.g. clover, vetches, bird's foot trefoil, lucerne, sainfoin) develop on their roots a number of spherical swellings, often spoken of as root-tubercles. These swellings do not develop on these plants if they are grown in sterilised soil; and examination shows them to be due to bacteria, which must normally exist in the soil. Contrary to what we should expect, the effect of these bacteria is not harmful, but distinctly the reverse; a much better crop of clover is obtained when the bacterial nodules are present on the roots. Obviously, the bacteria give as well as take. They have, indeed, the exceptional property of utilising the nitrogen of the air as a source of food; they do not depend on the soil for all the raw material of their proteins, but use atmospheric nitrogen instead of nitrates. As they die, their nitrogenous compounds are absorbed into their host plant, which has thus a source of nitrogen in addition to that supplied by the nitrates in the soil. Hence it is better fed, and the presence of the parasite is of mutual benefit to both sides: the host supplies carbohydrate, the bacteria supply proteins. It is now evident why farm land benefits when a crop of clover or sainfoin is ploughed in. The soil is enriched by the stock of nitrogen taken from the air by the leguminous bacteria.

A more intimate partnership of plants of different habit is to be found in the great family of *Lichens*. Here the main body of the plant is a fungus; but included in the meshes of its mycelium species of *Algæ* are found. These are green, and perform photo-synthesis for the benefit of the fungus. The two parts of the organism are inseparable: the lichen results from their harmonious co-operation. The process is often spoken of as *symbiosis* (Gr., a living together).

It is not to be supposed that because a plant grows on another it is necessarily a parasite. Ivy is not a parasite on the oak tree, because there is no *vital* connection between them; it merely uses the tree trunk as it would a wall, for support. Many tropical orchids grow perched high up on trees; they are called *epiphytes*, and depend on the tree only for elevation and support. Their tuberous roots are surrounded with a spongy tissue, which holds water and catches dust, thus forming its own soil.

On the other hand, a number of plants are troubled with insect parasites, which cause malformations and abnormal growths, such as the *galls* on the oak, lime, wild rose, etc.

26. By-products of Metabolism.—The production of carbohydrates and proteins, though the most vital, is not the only work of the plant. The living processes, acting

under special conditions, produce such substances as cellulose, lignin (the chief constituent of wood), and suberin (cork). The last two substances are especially connected with the death of the protoplasm. Cork, for example, is formed on exposed and threatened parts; it is, therefore, the chief component of the outer bark, which protects perennial stems. This is a dead tissue, formed by a special kind of activity in previously living tissue. In wood and bark we see how the plant adapts what would be waste matters to its own purposes. Many other valuable parts of plants are similarly no more than side-products of its vital work.

The coloured substances in the petals of flowers; the ethereal oils which cause their perfume; the tannin which darkens the bark; alkaloids, like quinine and morphine, which are poisonous and thus protect the plant against being eaten: these are other examples of by-products made to serve the plant's own purposes. Plants have no special means for disposing of their waste products; they therefore make use of them, in one way or another.

Occasionally, however, definite channels develop for the reception of such substances as the plant wishes to be rid of. When the stalk of the common spurge is broken across, a milky juice exudes; this is called *latex*, and is really the collected waste products of the plant. Latex is also plentiful in dog's mercury, poppy, dandelion, buttercup, etc.; and is specially interesting in the india-rubber plant.

In the case of the india-rubber plant, the latex has the property of solidifying on exposure to the air; it thus closes the wound which causes it to flow and protects the interior tissues. India-rubber is the latex.

The resin passages in Pines give us another kind of waste product. Many resins and gums are of great commercial value; they are the by-products of the plant's metabolism, often adapted for the purposes of protection, as in the case of the resinous covering of horse-chestnut buds.

A more general product of protein-metabolism is oxalic acid, which, in the form of oxalates, is of very wide occurrence in the vegetable kingdom.

It should be noted that crystals of calcium oxalate occur in most plants; acid potassium oxalate (salt of sorrel) is responsible for the acidity of rhubarb and sorrel. The vegetable acids that occur in fruits—tartaric, malic, —are doubtless of similar origin. E. W. E.

MINERALOGY.—I

1. Minerals defined.—THE term mineral includes so wide a range of the material products of Nature that it is most difficult to formulate an accurate, comprehensive, and scientific definition. It is usually held to imply the inorganic substances which build up the solid crust of the earth.

Substances of organic origin, such as coal, which has been formed from the decay of ancient vegetation; chalk, which is largely built up from the shells of innumerable microscopic marine animals; and pearls, which form as silvery gems in the shells of oysters, are excluded from the scientific study of minerals.

Some liquids, such as water, mercury, and perhaps petroleum, ought logically to be included among minerals, but except in the case of mercury it is found convenient to restrict the term to solids.

Minerals are not, however, confined to the earth alone. Meteorites which fall to the earth, captured on their mysterious journey through the solar system, are made up of minerals, so that it becomes necessary to extend the term to include certain extra-terrestrial substances.

2. A Piece of Granite.—Beneath the superficial covering of soil, rocks are encountered in the earth's crust, which may be examined in quarries, natural cliffs and caverns, railway cuttings and mines. Many of these rocks can be seen at once to consist of more than one kind of material, and as an example we may study a piece of Dartmoor Granite, a rock made up of three minerals, all of which may be seen unaided by the naked eye.

Perhaps the most striking is the pink or cream-coloured Felspar, which is distributed throughout the rock in large slab-like masses. Its sides are frequently parallel, and it appears to have a definite geometrical shape of its own. It will be found that the felspar breaks in flat glistening faces, and not in the irregular way that glass would have done.

In the more finely grained portions of the rocks, a black, brightly shining mineral can be seen. This is Mica, and its most remarkable property is that it can be easily split up into very thin flakes.

Between the mica and the felspar an irregular glassy substance will be found, filling up all the interstices. This mineral is Quartz, and it differs not only in colour from the other two, but also in the fact that it will not break, or *cleave*, as they do, parallel to any definite direction.

Granite thus consists of the three minerals, felspar, mica, and quartz, which can be separated mechanically from one another. The minerals themselves cannot, however, be broken up into anything simpler, unless chemical methods are used. They are, in fact, definite substances possessing a definite chemical composition, or solid solutions.

3. Crystals.—The term "crystal" was first given to the mineral we now call quartz, owing to its transparency and similarity to clear *ice* (κρύσταλλος is the Greek for ice).

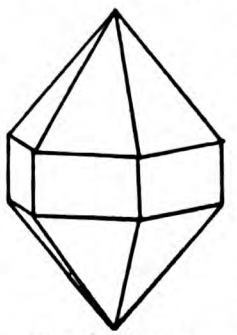


Fig. 1.—Quartz.

Afterwards it was found that this clear mineral often had a characteristic shape—a six-sided prism surmounted at one or both ends by a six-sided pyramid. Still later, other minerals, both transparent and opaque, were noticed to have an outward form bounded by plane surfaces, and the term "crystal" thus came to mean any mineral naturally limited by plane surfaces.

Now, it may be objected that the quartz we have just studied in the Dartmoor granite has no plane surfaces. Nevertheless, we do not hesitate to apply the term crystal to it, because in this case, as we shall see later, the quartz was obliged to grow after the felspar and mica, and therefore all it could do was to fill the spaces left between them. Sometimes cavities are found in certain varieties of granite, and there the minerals, having had a free space in which to develop, display their crystalline outlines to a greater advantage. Under these more favourable conditions, quartz, in every other way identical with that already examined, grows from the sides in clear beautifully formed crystals.

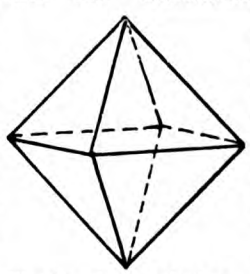


Fig. 2.—An octahedron.

A closer examination of the properties of crystals betrays the interesting fact that the outward geometrical form is related to the internal molecular structure. The atoms which build up a crystalline mineral are arranged in accordance with a definite architectural plan, which is a fundamental characteristic of the mineral.

It is of the greatest importance at the outset to realise that matter may assume one of two modes of aggregation. In the one, as for example in gases and nearly all liquids, the molecules are arranged haphazardly and the substance has no characteristic shape. In the case of substances which appear to be solid, such as glass, sealing-wax and pitch, and in which the molecules have no definite arrangement, their condition is said to be *amorphous*, i.e. shapeless. All true solids, however, assume the crystalline state in which matter appears in its most perfectly organised form.

Crystals may form, (1) from the cooling of the molten substance, e.g. prisms of sulphur; (2) from solution, e.g. octahedra of alum; (3) from vapour, e.g. octahedra of arsenic trioxide.

As the solid grows, the molecules are added to the crystalline edifice in an orderly fashion like bricks to a growing building.

If the conditions are such that the growing solid is free to develop, it assumes its outward form and is bounded by distinct plane surfaces. If, on the other hand, the growing solid is interfered with by others, its natural form may be only partially developed, or even entirely absent. Since, however, it possesses the same internal structure whether its boundaries are plane or restricted by other solids, the term *crystal* is applied with equal significance in each case.

4. Form and Symmetry of Crystals.—In crystals the plane surfaces are called faces, and the line formed by the meeting of two faces is called an edge.

Now, although the size of the faces may vary very widely, yet it is found that the angles between corresponding faces in all crystals of the same mineral are always the same. Crystal angles are, in fact, as definite and constant a characteristic of a mineral as its chemical composition, and serve equally as an index to its identity.

In individual crystals it will generally be found that the same angles, faces, edges, and corners are repeated more than once. An octahedron (Fig. 2) has, for example, six exactly similar corners, eight similar faces, and twelve similar edges.

This repetition of conditions is called *Symmetry*. If a crystal can be cut into two exactly similar halves it is said to have a plane of symmetry, and some crystals have many such planes. A cube, for example, has nine. When the similar parts of a crystal are repeated more than once when the crystal is rotated around an axis, then the axis is said to be an axis of symmetry. If the similar parts are repeated twice, the axis is said to be of twofold symmetry; if three times, the axis is one of threefold symmetry; similarly there may be axes of fourfold and sixfold symmetry.

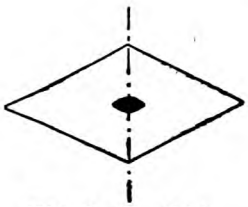


Fig. 3.—Twofold.

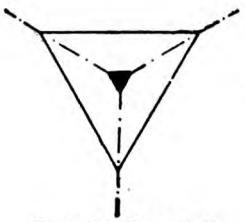


Fig. 4.—Threefold.

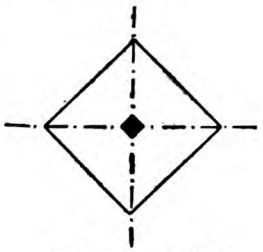


Fig. 5.—Fourfold.

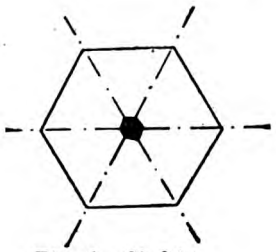


Fig. 6.—Sixfold.

Crystals may also have a centre of symmetry when the arrangement and location of edges, angles, faces, etc., at one side of the centre of the crystal are exactly like those diametrically opposite. All crystals having a centre of symmetry are bounded by pairs of parallel faces.

The faces of a crystal may thus, according to the symmetry, be arranged in sets, each face in a set having identical geometrical and physical properties. Such a group of faces is called a *Form*. Some crystals, such as cubes of fluor spar or galena, octahedra of magnetite (*see* Figs. 13 and 2), etc., are made up entirely of single forms. When more than one form is present the forms are said to be in *combination* (*see* Figs. 22, 23, and 24).

5. Crystallographic Axes. — As in geometry, crystal faces are described in reference to imaginary lines drawn through the crystal and known as the crystallographic axes. These may be regarded as a kind of simple scaffolding upon which the crystal structure is built.

The directions of the axes are chosen in the most convenient way. Thus, if axes of symmetry are present, those of the highest symmetry are chosen as crystallographic axes. Now, although there are hundreds of different kinds of crystals all of them may be simply classified according to their symmetry into thirty-two classes, which, in turn, fall into six groups or systems according to the crystallographic axes required for their description. The number of axes in all cases except one is three; in the other it is more convenient to have four axes.

6. The Crystal Systems.—The six systems to which all crystals can be referred may be defined as follows in terms of their axes:

I. *Cubic.* Three equal and interchangeable axes, all at right angles. Each is represented by the letter *a* (Fig. 7).

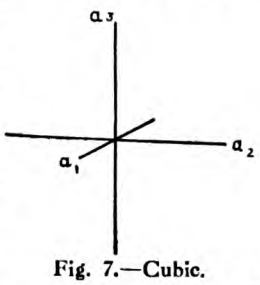


Fig. 7.—Cubic.

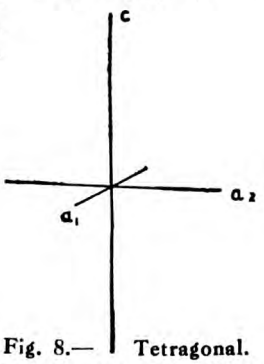


Fig. 8.—Tetragonal.

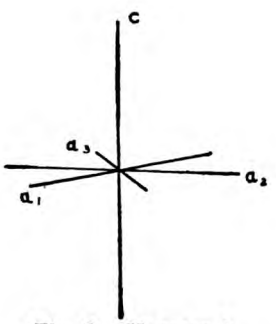


Fig. 9.—Hexagonal.

AXES OF CRYSTAL SYSTEMS.

II. *Tetragonal.* Three axes all at right angles. Two, which are placed in the horizontal position, are equal and interchangeable; the third is either shorter or longer. The axes are represented as a_1, a_2, c (Fig. 8).

III. *Hexagonal.* Four axes, three of which are placed in the horizontal position and are equal and interchangeable; the fourth is at right angles to them and is either shorter or longer. The axes are represented as a_1, a_2, a_3, c (Fig. 9).

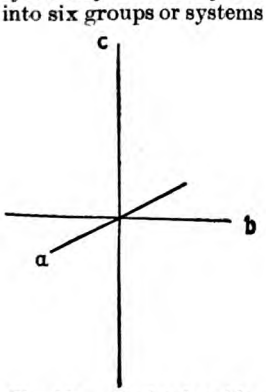


Fig. 10.—Orthorhombic.

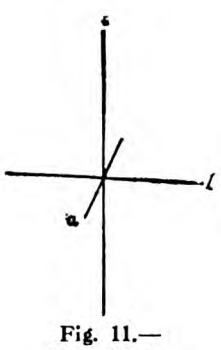


Fig. 11.—Monoclinic.

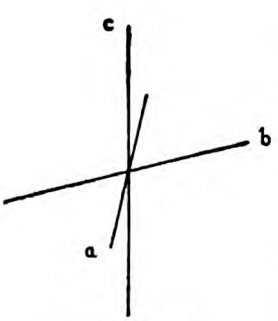


Fig. 12.—Triclinic.

AXES OF CRYSTAL SYSTEMS.

IV. *Orthorhombic.* Three axes, all unequal, and all at right angles (Fig. 10). The three axes are represented as:

a the brachy axis
b ,, macro ,,
c ,, vertical ,,

V. *Monoclinic.* Three axes all unequal. Two of these, *c* and *a*, are inclined to each other and are placed in a vertical plane; the third, *b*, is at

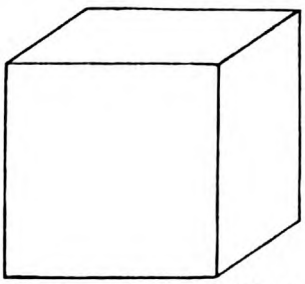


Fig. 13.—Cube (Galena Class).

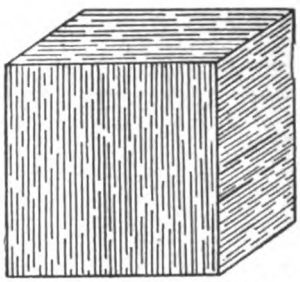


Fig. 14.—Cube (Pyrite Class).

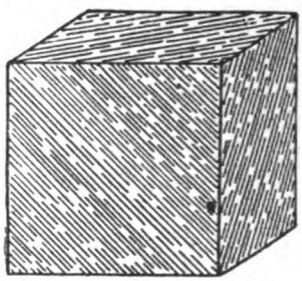


Fig. 15.—Cube (Tetrahedrite Class).

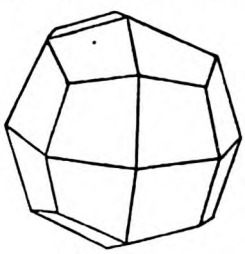


Fig. 16.—Trapezohedron.

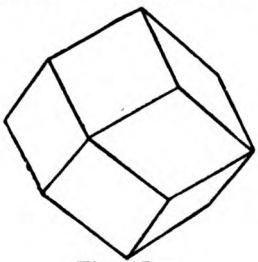


Fig. 17.—Rhombdodecahedron.

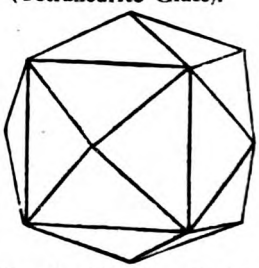


Fig. 18.—Tetrahexahedron.

right angles to the other two (Fig. 11). The axes are represented as:

a the clino axis
b ,, ortho ,,
c ,, vertical ,,

VI. *Triclinic.* Three axes, all unequal and all inclined (Fig. 12). They are represented as:

a the brachy or short axis
b ,, macro or long ,,
c ,, vertical ,,

as in the Orthorhombic system.

In the following sections the different possible forms belonging to the chief classes of the six systems are enumerated, and some are illustrated.

7. Forms of Cubic Crystals.

(*a*) *Galena Class.*

No. of faces.
6. Cube e.g. Galena.
8. Octahedron e.g. Magnetite.
12. Rhombdodecahedron e.g. Garnet.
24. Tetrahexahedron e.g. Fluor Spar.
24. Trapezohedron.
24. Tris-octahedron.
48. Hex-octahedron.

Minerals which belong to this class are Fluor Spar, CaF_2; Rock Salt, NaCl; Magnetite, Fe_3O_4; Spinel, $MgAl_2O_4$; Garnet, $Ca_3Al_2(SiO_4)_3$; Galena, PbS; Leucite, $KAl(SiO_3)_2$; Analcite $NaAl(SiO_3)_2 \cdot 2H_2O$.

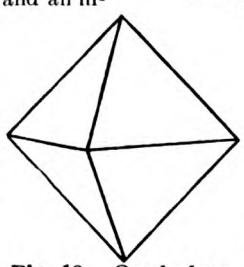


Fig. 19.—Octahedron.

(*b*) *Pyrite Class.*

No. of faces.
6. Cube e.g. Pyrite.
8. Octahedron e.g. ,,
12. Rhombdodecahedron e.g. ,,
12. Pyritohedron e.g. ,,
24. Trapezohedron.
24. Tris-octahedron.
12. Diploid.

Minerals which belong to this class are Pyrite, FeS_2, and Cobaltite, CoAsS.

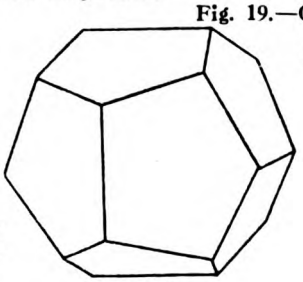


Fig. 20.—Pyritohedron.

(*c*) *Tetrahedrite Class.*

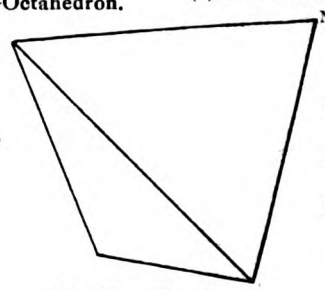


Fig. 21.—Tetrahedron.

No. of faces.
6. Cube.
4. Tetrahedron.
12. Rhombdodecahedron.
24. Tetrahexahedron.
12. Tris-tetrahedron.
12. Deltoid-dodecahedron.
24. Hexakis-tetrahedron.

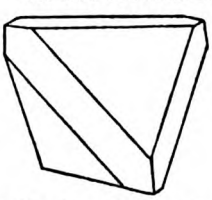


Fig. 22.—Cube and Tetrahedron.

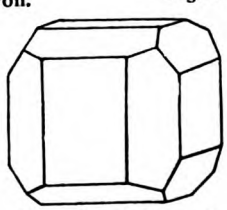


Fig. 23.—Cube and Pyritohedron.

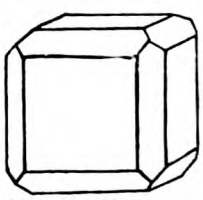


Fig. 24.—Cube and Rhombdodecahedron.

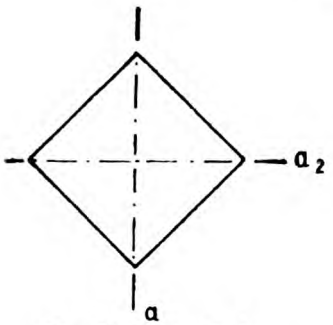


Fig. 25.—First Order.

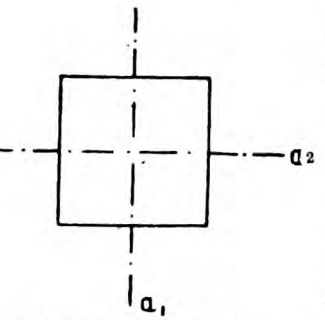
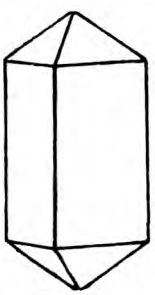


Fig. 26.—Second Order.

RELATION OF ORDER FORMS TO AXES.

Minerals which belong to this class are Tetrahedrite, Cu_3SbS_3; Zinc Blende, ZuS; Boracite, $Mg_7Cl_2B_{16}O_{30}$.

The different symmetry of the cubes in the above three classes is illustrated by the striations which sometimes occur on cubes of pyrite and zinc blende. (*See* Figs. 13, 14, and 15.)



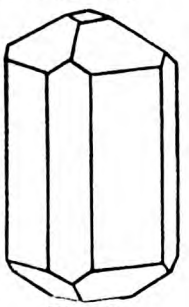


Fig. 27. Zircon. Fig. 28.

8. Forms of Tetragonal Crystals.

No. of faces	*Zircon Class.*
8	Tetragonal Pyramid 1st order.
4	,, Prism 1st ,,
8	,, Pyramid 2nd ,,
4.	,, Prism 2nd ,,
16.	Ditetragonal Pyramid.
8.	Ditetragonal Prism.
2.	Basal Pinacoid.

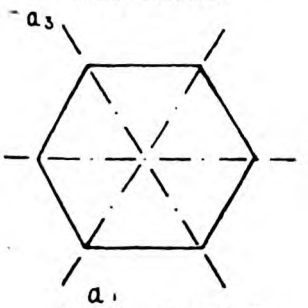


Fig. 29.—First Order.

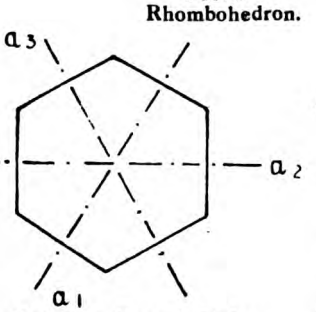


Fig. 30.—Second Order.

The relation of 1st and 2nd order forms to the axes is shown in Figs. 25 and 26.

Minerals which occur in this class are Zircon, $ZrSiO_4$; Cassiterite, SnO_2; Rutile, TiO_2. (*See* Figs. 27 and 28.)

9. Forms of Hexagonal Crystals.

No. of faces	(*a*) *Beryl Class.*
12.	Hexagonal Pyramid 1st order.
6.	,, Prism 1st ,,
12.	,, Pyramid 2nd ,,
6.	,, Prism 2nd ,,
24.	Dihexagonal Pyramid.
12.	,, Prism
2.	Basal Pinacoid.

The relation of the 1st and 2nd order forms to the axes is shown in Figs. 29 and 30.

(*See* Fig. 31, which is a crystal of Beryl, $Be_3Al_2(SiO_4)_3$.)

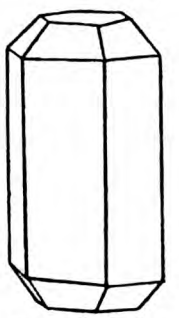


Fig. 31.—Beryl.

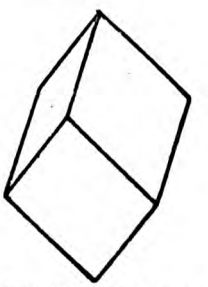


Fig. 32.—Negative Rhombohedron.

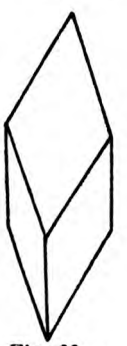


Fig. 33.—Positive Rhombohedron.

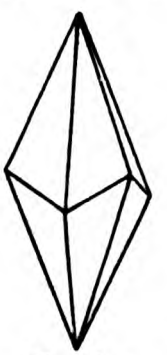


Fig. 34.—Scalenohedron.

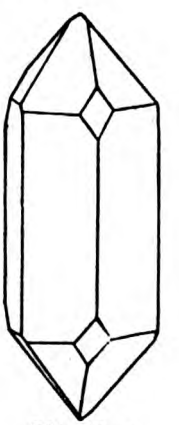


Fig. 35.—Quartz.

No. of faces	(*b*) *Calcite Class.*
6.	Rhombohedron.
6.	Hexagonal Prism 1st order.
12.	,, Pyramid 2nd ,,
6.	,, Prism 2nd ,,
12.	Scalenohedron.
12.	Dihexagonal Prism.
2.	Basal Pinacoid.

Half of the faces of the hexagonal 1st order pyramid taken alternately make a rhombohedron, of which there are, therefore, two possible cases, distinguished as positive and negative. The two types are indicated in Figs. 32 and 33.

Similarly from the dihexagonal pyramid two scalenohedra are derived.

Minerals which belong to this class are Calcite, $CaCO_3$; Dolomite, $CaMg(CO_3)_2$; Chalybite, $FeCO_3$. (*See* Figs. 32–34.)

(*c*) *Quartz Class.* (*See* Fig. 35, *p.* 211.)

No. of faces	
6.	Rhombohedron.
6.	Hexagonal Prism 1st order.
6.	Trigonal Pyramid.
3.	Trigonal Prism.
6.	Trigonal Trapezohedron.
6.	Di-trigonal Prism.
2.	Basal Pinacoid.

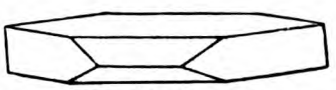


Fig. 36.—Barytes.

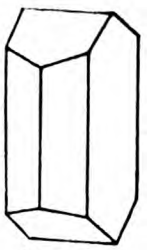


Fig. 37.—Orthoclase.

$CaSO_4.2H_2O$; Orthoclase, $KAlSi_3O_8$; the pyroxenes and amphiboles and many other rock-forming silicates. (*See* Figs. 37–40.)

Fig. 38.—Gypsum.

12. Forms of Triclinic Crystals.

No. of faces	*Axinite Class.*
2.	Quarter-pyramid.
2.	Hemi-prism.

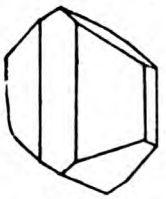


Fig. 39.—Augite.

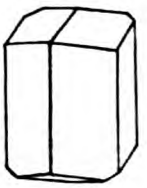


Fig. 40.—Hornblende.

10. Forms of Orthorhombic Crystals.

No. of faces	*Barytes Class.*
8.	Orthorhombic Pyramid.
4.	,, Prism.
4.	Macro-dome.
4.	Brachy-dome.
2.	Macro-pinacoid.
2.	Brachy-pinacoid.
2.	Basal Pinacoid.

Minerals which occur in this class are: Barytes, $BaSO_4$; Cerussite, $PbCO_3$; Olivine, $(Mg,Fe)SiO_4$. Topaz, $(AlF_2)AlSiO_4$.

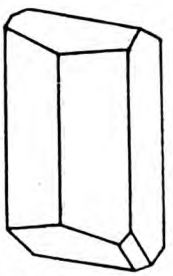


Fig. 41.—Albite.

11. Forms of Monoclinic Crystals.

No. of faces	*Gypsum Class.*
4.	Monoclinic Hemi-pyramid.
4.	,, Prism.
2.	,, Hemi-orthodome.
4.	,, Clino-dome.
2.	,, Ortho-pinacoid.
2.	,, Clino-pinacoid.
2.	,, Basal Pinacoid.

Two hemi-pyramids are possible and also two hemi-orthodomes. These are distinguished as positive and negative: positive when the form occupies the acute angle between the vertical and clino axes; negative when the form occupies the obtuse angle between the vertical and clino axes.

Minerals which belong to this class are Gypsum,

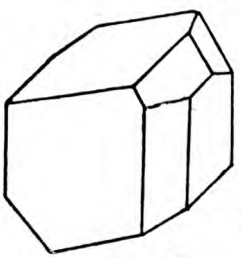


Fig. 42.—Axinite.

2. Hemi-macro-dome.
2. Hemi-brachy-dome.
2. Macro-pinacoid.
2. Brachy-pinacoid.
2. Basal Pinacoid.

Minerals which occur in this class are Axinite, $HCa_3Al_2B(SiO_4)_4$; Albite, $NaAlSi_3O_8$; Anorthite, $CaAl_2(SiO_4)_2$. (*See* Figs. 41 and 42.)

13. Twin Crystals.—Two crystals may be united, having grown together in the position in which they are found, so that each individual is symmetrically placed with regard to the other, either about a plane or an axis. The plane must be a possible face of each crystal and is called the twin-plane. Similarly the axis must be a possible edge of each crystal and is called the twin-axis.

Crystals thus joined together are said to be twinned. If the twin is composed of two individuals placed side by side, it is called a contact-twin. If the two crystals appear to pass through each other, the twin is a penetration-twin.

Fig 43.—Cubic: Penetration-twin of Fluor Spar. Fig. 44.—Tetragonal: Contact-twin of Cassiterite. Fig. 45.—Orthorhombic: Penetration-twin of Staurolite. Fig. 46.—Monoclinic: Penetration-twin of Orthoclase (Carlsbad type). A. H.

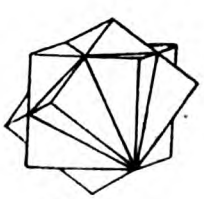


Fig. 43.—Fluor Spar.

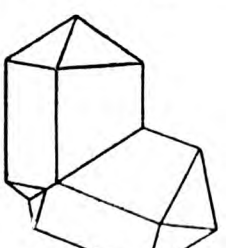


Fig. 44.—Cassiterite.

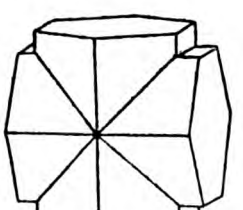


Fig. 45.—Staurolite.

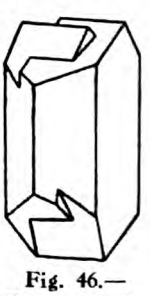


Fig. 46.—Carlsbad Twin of Orthoclase.

Continued from page 162.

LANGUAGES:

Contributors:—LATIN, GREEK and FRENCH (E. A. Baker, M.A., D.Lit.). GERMAN (M. A. Lewenz, M.A. [Lond.]). SPANISH, RUSSIAN and ITALIAN (Alfred Calvert, First Prizeman in Modern Languages, R.S.A., London).

LATIN.—XXVIII

The Ablative Case (*Continued*)

THE use of the Ablative with verbs and adjectives may be summarised as follows:

(1) The ablative is used as the direct object after the following verbs:—**dignŏr**, *I am worthy of*, **frŭŏr**, *enjoy*, **fungŏr**, *perform*, **nītŏr**, *lean upon*, **pŏtĭŏr**, *gain possession of*, **ūtŏr**, *use*, **ăbūtŏr**, *misuse*, **vescŏr**, *feed upon*. If we analyse carefully the meaning of these verbs we shall see that they are essentially reflexive verbs, and the ablative they appear to govern was originally instrumental. Thus **fungŏr** may be translated *I busy myself*, and is naturally constructed with the instrumental ablative. Similarly **ūtŏr** means *I employ myself with* or *I avail myself of*, whence the meaning *I use*; and **vescŏr**, *I feed myself*, whence *I eat* or *enjoy*.

The following examples bring out these reflexive meanings:—

Fungor **vice** cotis.
I discharge the office of a grindstone.
Commoda **quibus** utimur.
The advantages of which we avail ourselves.
Oratione aliena usus est.
He made use of another's speech.
Lacte, caseo, carne vescuntur.
They feed on milk, cheese and flesh.
Paratissimis voluptatibus vescebantur.
They enjoyed the most elaborate pleasures.
Te fruimur.
We enjoy your society.
Caro amico fruitur.
He enjoys (the company of) his dear friend.
Consilio atque **auctoritate** mei amici nitor.
I rely upon the advice and support of my friend.
Imperio totius Galliae potitus est.
He became master of the empire of all Gaul.

(2) The phrases **ŏpŭs est** and **ūsŭs est**, *there is need of*, are followed by the instrumental ablative, as in:—

Opus est **magistratibus**.
There is need of magistrates (lit., *There is work to be done by magistrates*).
Nunc **viribus** usus est.
Now there is need of strength (lit., *Now advantage is to be gained by strength*).

In the same way **frĕtŭs**, *relying on*, takes an instrumental ablative, as in:—

Omnes mortales **diis** freti sunt.
All mortals rely upon the gods.

(3) The ablative with which **dignŭs**, *worthy*, and **indignŭs**, *unworthy*, are constructed may perhaps be best regarded as an ablative of price. Examples:—

Dignus **domino** servus. *A slave worthy of his master.*
Te **omni honore** indignissimum iudicat.
He judges you most unworthy of all honour.

The Locative Case

Traces of the locative case remain both in surviving examples in some nouns of the first and second declensions and in usages transferred to other cases. For the most part it is merged in the ablative in classical Latin, and entirely so in the plural. The locative denotes (1) the place where (and in some few instances the time when) an action is performed, and (2) the amount or cost at which a thing or person is valued or sold.

(1) The locative occurs regularly with the names of towns or small islands of the first or second declension of singular number, with a few such of the third declension, and with some nouns of common use. Examples:—

Romae quotannis consules bini creabantur.	*At Rome two consuls were elected every year.*
Conon plurimum **Cypri** vixit.	*Conon mostly lived at Cyprus.*
Milites **Karthagini** relicti erant.	*The soldiers were left at Carthage.*

The commonest locatives among nouns that are not place-names are the following:—**ănĭmī**, *at heart*, **bellī**, *in war*, **dŏmī**, *at home*, **humī**, *on the ground*, **mīlĭtĭae**, *in warfare*, **rūrĕ** (or **rūrī**), *in the country*, **terrae**, *on the earth*. **Dŏmī** is an instance of the sur-

vival of the locative in the fourth declension. **Anĭmī**, **bellī**, and **mīlĭtĭae**, are used in a metaphorical sense. Examples :—

Rex **animi** anxius erat.
The king was anxious in mind.
Quibuscumque rebus vel **belli** vel **domi** possunt rempublicam augent.
By whatever means they can either in war or in peace they support the state.
Cadmus spargit **humi** dentes.
Cadmus scatters his teeth upon the ground.
Illorum virtus fuerat **domi militaeque** cognita.
Their valour had been proved at home and abroad.
Si illi sunt virgae **ruri** at mihi tergum **domi** 'st.
If he has switches in the country, I have a back at home.
Bellum **terrae** comparat.
He prepares for war on land.

The only examples in classical Latin of substantives retaining the locative in the temporal sense are **lucī**, *by day*, and **vespĕrī**, *in the evening*. Examples :—

Quis audeat **luci** ?
Who would venture by day ?
Vesperi hortes repulsi sunt.
In the evening the enemy were beaten off.

(2) The locative singular neuter of some adjectives and the locative of some nouns are used to denote price or value. Examples :

Tanti eam emit.
He bought it for so much.
Quanti sua funera vendunt ?
For how much do they sell their lives ?
Ego istuc abs te factum **nihili** pendo.
I value as nothing that which you have done.
Ego, quae tu loquere, non **flocci** facio.
I do not care a straw for what you say.

These locatives were taken by the Romans as genitives, and by analogy the genitives **plūrĭs**, *more*, **mĭnōrĭs**, *less*, and **hūiŭs**, *at that*, were used in the same way to denote cost or value, thus :—

Pluris fundum emit.
He bought the estate at a greater price.
Vendo meum non pluris quam ceteri, fortasse etiam **minoris**.
I sell my property at no greater price than the rest of the world ; perhaps even at a lower price.
Non **huius** facio. *I do not care that for it.*

Note that when the exact amount of the price is given the ablative is used, as in :—

Viginti **talentis** unam orationem Isocrates vendidit.
Isocrates sold a single speech for twenty talents.

Exercise 27

Translate into English :—

1. Qui regno ita potibus urbem novam, conditam vi et armis, iure eam legibusque ac moribus de integro condere parat. 2. Gabiis receptis Tarquinius pacem cum Aequorum gente fecit, foedus cum Tuscis renovavit. 3. Non viribus aut velocitatibus aut celeritate corporum res magnae geruntur. 4. Duce hostium occiso urbem primo impetu capit. 5. Inde exercitu victore reducto ipse in Capitolium ascendit. 6. Valetudo opportuna est ut dolore careas et muneribus fungare corporis.

Translate into Latin :—

1. The eyes are sometimes capable of not performing their function. 2. He judges thee most unworthy of any (all) honour. 3. A man most worthy of his father, his grandsire, and his progenitors. 4. How long will thy mind be fixed upon the ground ? 5. He is certainly supplied with that (that is certainly at home).

Key to Exercise 22

1. There is a certain pleasure in tears. 2. She showed herself truly a goddess by her gait. 3. We and the things that are ours are destined to death. 4. Every one is to be trusted in his own art. 5. Do not believe that everything you see glitter is gold. 6. I would rather err with Plato than think true things with those men.

1. Legatus interrogatus nihil de his rebus respondit. 2. Romanus Athenas, Atheniensis Romam videre vult. 3. Virtus est vitium fugere. 4. Praedae et rapinarum cupiditas caeca te rapiebat. 5. Quod neque oculis, neque auribus, neque ullo sensu percip potest. 6. Eam dico urbem cui bellum intulisti.

Key to Exercise 23

1. To give as it were citizenship to philosophy, which hitherto indeed seems to have been merely a sojourner at Rome. 2. To be undecided, to go astray, to be ignorant, to be deceived, we consider bad and disgraceful. 3. He caused a bridge to be made over the Arar. 4. The third brother slew three Curiatii, the hope of the Alban gens. 5. Hannibal used to live as if there were no pleasure in eating and drinking. 6. Often therefore as I thought about friendship this has been wont to appear to me most worthy of consideration.

1. Quid me istud rogas ? inquam. 2. Irrupit in Galliam, quam sibi armis animisque infestam inimicamque cognovit. 3. Labienus, cui Caesar imperium commiserat, ab hostibus interfectus est. 4. Eos qui philosophos imitantur laudamus. 5. Legati Caesaris nihil auctoritatis apud milites habebunt. 6. Sub hoc sacremento sex et triginta annos militavi.

Key to Exercise 24

1. The personality of Ledius seems to me suitable for discoursing upon the subject of friendship. 2. He sent his son out to some neighbour of his. 3. By fate a fugitive he came to Italy and the Lavinian shores. 4. He smote and put to flight the army, and followed it up in rout. 5. I believe there were then some also who silently contended that the king had been torn to pieces at the hands of the senators. 6. Go home.

1. Castris idoneum locum deligit. 2. Ubi ea dies, quam constiterat cum legatis, venit. 3. Ex eo proelio circiter millia hominum centum et triginta superfuerunt. 4. Iugurtha omni Numidiae imperare parat. 5. Virgo nupsit ei cui Caecilia nupta fuerat. 6. Equitatui interponit auxilia levis armaturae.

Key to Exercise 25

1. This, at least, in my opinion, ought to be a most unquestionable token of my affection. 2. Abundance of grain and a tolerable supply of other things. 3. As many persons as there are alive so many thousand interests are there. 4. This is the peculiar nature and strength of the soul. 5. They attribute this name of God to the mind and soul of all nature. 6. Not less often did he bethink himself of thy power than of thy fairness.

1. Omnium ineptiarum haud scio an ulla sit maior. 2. Extant orationes ex quibus existimari de ingenio eorum potest. 3. Crescit amor nummi quantum ipsa pecunia crescit. 4. Alterius ducis causa melior videbatur, alterius firmior. 5. Nihil novi reperitur. 6. Pecuniarum repetundarum reus.

E. A. B.

FRENCH.—XXVIII

Adjectives.—We have seen in Lesson V that an adjective relating to two substantives of the same gender must agree with them in gender and be put in the plural, and that if the substantives are of different genders it must be put in the masculine plural.

When, however, the substantives are synonymous, or when the last of a series of substantives is specially emphasised, the adjective may agree with the last only, as in—

Toute sa vie n'a été qu'un travail, qu'une occupation continuelle,	*His whole life has been nothing but continual labour and occupation.*
Le fer, le bandeau, la flamme est toute prête,	*The knife, the band, the fire is all ready.*

The adjective **feu**, *late, deceased*, is invariable before the definite article, but variable when placed after the determining word, as in—

Feu les princes *or* les feus princes,	*The late princes.*

Note that **feu la reine**, *the late queen*, implies that no queen has succeeded the deceased queen; **la feue reine** implies the contrary.

The adjectives **nu**, *bare*, and **demi**, *half*, are invariable before the noun, in which case they are joined to it by a hyphen, but agree with it when placed after; thus—

Il était nu-tête,	*He was bare-headed.*
Toujours tête nue,	*Always bare-headed.*
Une demi-heure,	*A half-hour.*
Une heure et demie,	*An hour and a half.*

Adjectives preceding **gens**, *people*, are in the feminine when they precede the noun, masculine when they follow, thus—

Les bonnes gens sont heureux,	*The good people are happy.*

The adjective **tous** before **gens** is in the masculine except when it is followed by an adjective distinctively feminine, as in—

Tous les gens, tous les pauvres gens,	*All the people, all the poor people.*
Toutes les bonnes gens,	*All the good* (or *simple*) *people.*

Nouns used as adjectives to denote colours remain invariable, as in—

Des étoffes noisette, des robes olive,	*Hazel-coloured material, olive-coloured dresses.*

Compound adjectives remain invariable when they denote colours; in other cases the last component agrees, the first being regarded as an adverb modifying the second, thus—

Cet oiseau a le bec et les pieds gris-brun,	*This bird's bill and feet are dark brown.*
Une fille nouveau-née,	*A new-born daughter.*
Des moutons mort-nés,	*Still-born sheep.*

Be careful to observe that an adjective used adverbially is invariable, as in—

La chair de cet animal sent très mauvais,	*The flesh of this animal smells very bad.*

Complements of Adjectives are nouns or verbs completing or defining the sense of the adjectives. They are connected with the adjective by one of the prepositions **à**, **de**, **dans**, **en**, **sur**, etc., thus—

Cet homme est digne de louange,	*This man is worthy of praise.*
Ce général est digne de commander,	*This general is worthy to command.*

Here the noun **louange** and the infinitive **commander** are complements of the adjective **digne**.

When an adjective follows the verb **être**, *to be*, used impersonally, the true subject being a verb in the infinitive, the preposition **de** precedes the infinitive, as in—

Il est beau de mourir pour son pays,	*It is noble to die for one's country.*
Il est plus aisé d'être sage pour les autres que pour soi-même,	*It is easier to be wise for others than for oneself.*

Observe that in other cases the adjective takes the preposition proper to it (see below) between it and the following verb, as in—

Cela est beau à voir,	*That is beautiful to see.*

Adjectives denoting feelings of kindness, unkindness, etc., towards persons or animals usually require the preposition **envers**, *towards*, thus—

Il est affable envers tout le monde,	*He is affable to everybody.*
Ne soyez pas cruel envers les animaux.	*Do not be cruel to animals.*

Learn the following lists of adjectives with the prepositions proper to them :—

(1) Adjectives taking the preposition **de**—

absent de, *absent* (*from*).
ambitieux de, *ambitious of.*
amoureux de, *in love with,*
avide de, *eager for.*
capable de, *capable of, to.*
complice de, *accomplice in.*
content de, *pleased with.*
curieux de, *curious to.*
dédaigneux de, *disdaining to.*
désireux de, *desirous to, of.*
différent de, *different from.*
digne de, *worthy of* or *to.*
envieux de, *envious of.*
esclave de, *a slave to.*
exempt de, *exempt from.*
fier de, *proud of.*
fort de, *confident in.*
fou de, *excessively fond of.*
glorieux de, *proud of.*
honteux de, *ashamed of.*
impatient de, *impatient of.*
incapable de, *incapable of.*
inconsolable de, *inconsolable for.*

indigne de, *unworthy of.*
indigné de, *indignant with.*
inquiet de, *uneasy about.*
ivre de, *intoxicated with.*
las de, *weary of.*
mécontent de, *displeased with.*
plein de, *full of.*
ravi de, *glad to, of.*
reconnaissant de, *grateful for.*
redevable de, *indebted for.*
soigneux de, *careful of, to.*
sûr de, *sure of.* [*to.*
tributaire de, *tributary*
victime de, *victim of, to.*
vide de, *void of.*

(2) Adjectives taking the preposition **à**—

accessible à, *accessible to.*
adhérent à, *adhering to.*
agréable à, *agreeable to.*
aisé à, *easy to.*
antérieur à, *prior to.*
ardent à, *zealous for.*
assidu à, *assiduous for.*
attentif à, *attentive to.*
bon à, *good for.*
cher à, *dear to.*
conforme à, *similar to.*
contraire à, *contrary to.*
difficile à, *difficult to.*
enclin à, *prone to.*
étranger à, *a stranger to.*
exact à, *exact in.*
facile à, *easy to.*
fatal à, *fatal to.* [*to.*
favorable à, *favourable*
formidable à, *formidable to.*
impénétrable à, *impenetrable to.*
indispensable à, *indispensable to.*
insensible à, *insensible to.*
invisible à, *invisible to.*
naturel à, *natural to.*
nécessaire à, *necessary to.*
nuisible à, *hurtful to.*
odieux à, *odious to.*
postérieur à, *posterior to.*
préférable à, *preferable to.*
propice à, *propitious to.*
propre à, *fit for.*
rebelle à, *rebellious towards.*
redoutable à, *formidable to.*
semblable à, *similar to.*
sujet à, *subject to.*

(3) Adjectives taking other prepositions—

bon pour, *kind towards.*
célèbre pour *or* par, *famous for.*
ignorant en, *ignorant of.*
indulgent pour, *indulgent towards.*
insolent avec, *insolent to.*

VOCABULARY

l'agrément, m., *the charm, attraction.*
aisé, *easy.*
l'alarme, f., *the fear, apprehension.*
le berger, *the shepherd.*
le bord, *the edge, boundary.*
le bras, *the arm.*
camper, *to encamp.*
casser, *to break.*
célèbre, *celebrated.*
le chien, *the dog.*
chrétien, *Christian.*
devenir, *to become.*
enchanter, *to charm.*
le religieux, *the monk.*
remarquable, *remarkable.*
riche, *rich.*
Romain, *Roman.*
l'ennemi, *the enemy.*
enfler, *to swell.*
le gazon, *the turf.*
habiter, *to inhabit.*
imprimer. *to print.*
jaloux, *jealous.*
Léon, *Leo.*
mobile, *changing.*
la naissance, *the birth.*
naturel, *natural.*
le nerf, *the nerve.*
le nombre, *the number.*
le papier, *the paper.*
poli, *civil.*
posséder, *to possess.*
le seigneur, *the lord.*
semblable, *similar to, like.*
transplanter, *to transplant.*
la voûte, *the vault.*

Exercise 53

1. Cet homme n'est pas content. 2. Cet homme n'est pas content de son fils. 3. Il est plus glorieux de se vaincre soi-même, que de vaincre les autres. 4. Cela n'est pas aisé à faire. 5. Il faut être charitable envers les pauvres, et poli envers tout le monde. 6. Qui vit content de rien possède toute chose. 7. Il n'est pas de Romain qui ne soit désireux de vous donner la main. 8. L'ignorance est toujours prête à s'admirer. 9. Insensible à la vie, insensible à la mort, il ne sait quand il veille, il ne sait quand il dort. 10. Cet air pur, ces gazons, cette voûte mobile. 11. Ici tout plaît au cœur, tout enchante les yeux. 12. Mon père, ma mère, et mes sœurs sont arrivés. 13. Je vois que mon bras enfle. 14. Toutes les semaines j'écris des lettres à mon frère, et j'en reçois de lui. 15. Cinna et Carbon, un de ses lieutenants, se campèrent sur les bords du Tibre. 16. Ce livre est bien imprimé ; le papier en est excellent. 17. J'habite la campagne ; les agréments en sont sans nombre. 18. Paris est une ville remarquable ; les étrangers admirent la beauté de ses édifices. 19. Léon dix. 20. Chapitre dix.

Exercise 54

1. The tenth year. 2. Sixth book, tenth chapter. 3. Those languages are rich ; I admire their beauties. 4. Those languages have their beauties. 5. The country has its charms. 6. You always fall into the same apprehensions. 7. The gods themselves become jealous of the shepherds. 8. Those very walls, my lord, may have eyes. 9. The lion is nothing but (all) nerves and sinews. 10. The dog is nothing but (all) zeal, ardour, and obedience. 11. When one is kind to everybody, one is so towards no one. 12. He was celebrated for his doctrine as well as for his birth. 13. Religion is necessary and natural to man. 14. My head aches. 15. Charles has broken his arm. 16. It is morals that make good company. 17. It is they that come. 18. Are they monks and priests who speak thus ? Are they Christians ? 19. Your father and I have long been enemies to one another.

Key to Exercise 46

1. Combien de temps y a-t-il qu'il demeure à Paris ? 2. Il y a dix ans qu'il y demeure. 3. Il y a un an qu'il est en Angleterre. 4. Il y a plus de deux mois que nous sommes ici. 5. Savez-vous combien il y a de Paris à Vienne ? 6. Y a-t-il longtemps que vous avez lu cette affiche ? 7. Il y a plus d'un an que je l'attends. 8. Le notaire vous accompagna-t-il hier ? 9. Il m'accompagna jusque chez M. votre frère. 10. Votre compagnon prit-il congé de vous hier ? 11. Il a pris congé de moi ce matin. 12. Il peignit hier toute la journée, mais le portrait n'est pas encore fini. 13. Il n'avait pas peur de tomber, mais il craignait de se tromper. 14. Conduisiez-vous votre fils à l'école ? 15. Je le conduisais à l'église. 16. Qu'est-ce que le monsieur lisait ? 17. Il lisait une lettre qu'il venait de recevoir. 18. Ne savez-vous pas où demeure mon père ? 19. Je sais où il demeure, mais je n'ai pas le temps d'aller chez lui aujourd'hui. 20. Combien de temps y a-t-il que M. votre fils apprend le grec ?

Key to Exercise 47

1. Did you not run to your brother's aid as soon as you saw him in danger ? 2. Did you read the book yesterday that I lent you ? 3. I was drinking a glass of wine. 4. Do you think that he will come ? 5. They enjoyed themselves greatly in your company. 6. You must study a great deal to be so tired. 7. That will make you ill. 8. That seems as clear as a pike-staff. 9. Do your duty. 10. They disappeared immediately. 11. Do not go and imagine that she displeases me in any respect. 12. Whence could that arise ? 13. That is where you see badly (are wrong). 14. It came out perfectly clear in that day's discussion. 15. You think you see the gestures of five hundred of your contemporaries. 16. I believed that it was for you to tell me something. I believe nothing of the kind. 17. I felt it last winter one December night. 18. That day I understood what it was to be afraid. 19. I understood it still better on another occasion. 20. I did not learn all that till later. E. A. B.

GERMAN.—XXV

Conjunctive Mood (*continued*).—*The Use in Indirect Statement.*—The Conjunctive is often used to express an opinion or statement of someone else's. It is, however, not used when the exact words of the other person are quoted, but only when these are reported indirectly. Thus, er ſagte er ſei mit dem Entſchluß zufrieden, *he said he was satisfied with the decision;* ſie glaubte er ſei noch nicht fort, *she believed he had not yet gone.* In both of the above examples wäre might be used instead of ſei without affecting the meaning in the least.

The student should note that when the conjunction daß is omitted the following dependent clause has the order of a principal clause. Of course, the above might equally well be expressed with the conjunction daß, and would then run as follows: er ſagte, daß er damit zufrieden ſei (or wäre), etc.

Such clauses are always dependent noun clauses, and the verbs on which they depend are mostly of the following kinds: Verbs of reporting, making a statement, asserting, promising, reminding, and so on; verbs of feeling, knowing, perceiving, imagining, concluding, and so on; verbs which express the emotions (such as joy, sorrow, fear, etc.) aroused by the sight or thought of something.

Sometimes the verb on which the indirect statement depends is omitted. Thus, ſie wollten nichts mit ihm zu tun haben weil er kein ehrlicher Mann wäre, *they would have nothing to do with him because* (it was supposed that) *he was not an honest man.*

Again, the clause may depend on a noun having a meaning akin to those of the verbs mentioned above. Thus, er lief ſo ſchnell er konnte aus Angſt daß er zu ſpät käme, *he ran as fast as he could for fear that he would be too late;* der Glaube daß der Krieg bald vorbei ſein würde war nicht berechtigt, *the belief that the war would soon be over was not justified.*

We have already noted that the tenses of the Conjunctive are interchangeable (as regards the present and the past), in indirect statements; as a general rule, however, that tense is used which would have been used in the original statement, and consequently the Present, Perfect, and Future are commoner than the Past, Pluperfect, and Future Perfect.

If a past tense would have been used in the original statement, then of course the indirect statement also employs the past. Thus, er ſagt ſie ſei angekommen, *he says she has arrived* (the actual words used would be ſie iſt angekommen); ſie glaubte er werde heute kommen, *she believed he would come to-day* (the actual words would be er wird heute kommen); er war der Anſicht ſie habe es vergeſſen, *he was of the opinion that she had forgotten it* (the actual words would be ſie hat es vergeſſen).

The student will notice that in this respect the German differs from the English use; we always use the past tenses in such indirect statements, whereas in German, though the tenses corresponding to the English are admissible, the others are more generally used.

If a past tense would have been used in the original statement, then, of course, a past tense must be used in the indirect statement as well. Thus, er ſagte ſie wäre nicht da als er ankam, *he said she was not there when he arrived* (the original words would be ſie war nicht da).

Note that if the clause depends on a verb in the present, the present and past tenses of the Conjunctive are not interchangeable. Thus, er ſagt ſie ſchreibe gerade einen Brief und könne deshalb nicht kommen, *he says she is just writing a letter and can therefore not come.* If we alter the above to er ſagt ſie ſchriebe gerade einen Brief und könnte deshalb nicht kommen, then we change the meaning to *he says she was just writing a letter and therefore could not come.*

In statements such as those in the foregoing paragraphs the Indicative may be used in place of the Conjunctive, when the statements are looked upon by the speaker as being actual and real facts. Thus, er wußte daß es ihm nicht gelungen war, *he knew that he had not succeeded.*

In such cases it is possible to have a past tense in the dependent clause, even if the principal verb is in the present. Thus, er ſagt daß er damals nicht in London war, *he says that he was not in London at that time.*

On the whole, in conversational style, the Indicative is used in such cases more than the Conjunctive.

Occasionally a Past Conjunctive is used in a somewhat similar way in asking a question by which you wish to imply incredulity. Thus, er hätte ſeinen Herrn beſtohlen? *he* (is supposed) *to have robbed his master?* This of course in answer to a statement which has been made on the subject.

The compound (alternative) form of the Past Conjunctive is sometimes used instead of the Future, just as the Past is used instead of the Present (see above). Thus, er ſagte daß ſie nicht kommen würde, *he said that she would not come,* instead of er ſagte daß ſie nicht kommen werde.

The following are a few special cases of the use of the Conjunctive which scarcely come under any of the above headings.

The Present Conjunctive is used in clauses which contain an indefinite relative. Thus, ich will keinen ſehen, wer es auch ſei, *I will see no one, whoever it may be;* wohin er auch gehen möge, dieſer Gedanke wird ihn immer verfolgen, *wherever he may go, this thought will pursue him.* However, the Indicative is equally admissible in such sentences.

The Conjunctive is also used in final clauses introduced by the conjunctions damit, um daß, daß, *that, so that, in order that.* Thus, ich habe mich ſehr geeilt damit ich zeitig hier ſei, *I hurried very much so that I might be here early;* er bot alles auf daß das Kind leben möchte, *he did everything possible so that the child might live.* Here again the Indicative may be used.

Akin to the Conjunctive used in indirect statements is that used after daß in noun clauses indicating something that is foreseen, desired, or probable. Thus, er beſteht darauf daß ſie ſofort nach Hauſe komme, *he insists that she should come home at once;* es iſt von der größten Wichtigkeit daß er benachrichtigt werde, *it is of the utmost importance that he should be informed.*

The Imperative Mood.—The use of the Imperative is the same in German as in English. When using the 2nd persons singular and plural the Personal pronouns are, as a rule, omitted, however they may be expressed, and in that case they follow the verb. Thus, bleibe hier, *stay here,* or bleibe du hier, *stay* (you) *here;* geht fort, *go away;* but geht ihr zwei fort, die andern ſollen bleiben, *you two go away, the others are to stay.*

The pronouns are only expressed when special emphasis is laid on the person or persons addressed to distinguish them from others.

When a reflexive verb is used in the Imperative the governed pronoun must, of course, be expressed, and it always follows the verb. Thus, erhebe dich, *get up;* eilt euch, *hurry.*

The other persons of the Imperative are all borrowed from the Present Conjunctive, i.e. the 3rd persons singular and plural and the 1st person plural. The personal pronouns are always expressed and follow the verb. However, the only ones of these in common use are the 1st person plural and the 3rd person plural used in the polite form of address. Thus, gehen wir, *let us go;* kommen Sie, *come.*

The Past Participle and the Present Infinitive are both used colloquially in an Imperative sense. Thus, aufgepaßt, aufpaſſen, *attention.*

VOCABULARY

Bote, w.m., *messenger.*
wandern, w., *to wander.*
ſpringen, s., *to spring.*
entgegen, *towards* (gov. dat.).
Schritt, s.m.2, *step.*
Wicht, s.m.2, *wretch.*
einem den Weg vertreten, s., *to bar the way for someone.*
erwiedern, w., *to reply.*
Befehl, s.m.2, *command.*
ſich weigern, w., *to refuse.*
heftig, *violent.*
behalten, s., *to retain, keep.*
niederſchlagen, *to fell,* s.
neben, *next to.*
zuſammenſinken, s., *to collapse.*
zwar, *moreover.*
ſich erheben, s., *to rise.*
liegen, s., *to lie.*
anfüllen, w., *to fill up.*
indem, *meanwhile.*
geſund, *healthy.*
Blick, s.m.2, *glance.*
ohnmächtig, *weak, fainting.*
heran'gehen, s., *to approach.*
auf'richten, w., *to raise up.*
Flaſche, w.f., *bottle, flask.*
Trunk, s.m.2, *drink.*
bis *till.*
indem (conjunction), *while, as.*
helfen, s., *to help.*
verſchonen, w., *to spare.*
machen, w., *to make.*
dankbar, *grateful.*
unverſehens, *unexpectedly.*
ab'holen, w., *to fetch.*
Tod, s.m., *death.*
Rieſe, w.m., *giant.*
unbekannt, *unknown.*
halt, *halt, stop.*
weit, *far.*
zerdrücken, w., *to squash.*
keck, *bold.*
widerſte'hen, s. (gov. dat.), *to oppose, resist.*
gehorchen, w. (gov. dat.), *to obey.*
ringen, s., *to wrestle, fight.*
Kampf, s.m.2, *fight, struggle.*
Oberhand, s.f.2, *ascendency.*
Fauſt, s.f.2, *fist.*
Stein, s.m.2, *stone.*
beſiegt, *vanquished.*
kraftlos, *weak.*
Ecke, w.f., *corner.*
bleiben, s., *to remain.*
Platz, s.m.2, *room.*
friſch, *fresh.*
werfen, s., *to throw.*
hin und her, *hither and thither.*
erblicken, w., *to see, catch sight of.*
mitleidig, *compassionate.*
einflößen, w., *to imbue, instil, pour.*
ſtärken, w., *to strengthen.*
warten, w., *to wait.*
Bein, s.n.2, *leg.*
kennen, w., *to know, be acquainted with.*
Ausnahme, w.f., *exception.*
damit, *so that.*
verſprechen, s., *to promise.*
überfallen, s., *to attack.*

Exercise 57

Die Boten des Todes.

Vor alten Zeiten wanderte einmal ein Rieſe auf der großen Landſtraße, da ſprang ihm plötzlich ein unbekannter Mann entgegen[1] und rief: „Halt! keinen Schritt[2] weiter!" „Was!" ſprach der Rieſe, „du Wicht,[3] den ich zwiſchen den Fingern zerdrücken kann, du willſt mir den Weg vertreten? Wer biſt du, daß du ſo keck reden darfſt?" „Ich bin der Tod[4]", erwiederte der andere, „mir widerſteht Niemand, und auch Du mußt meinen Befehlen gehorchen." Der Rieſe aber weigerte ſich, und fing an, mit dem Tode zu ringen. Es war ein langer, heftiger Kampf, zuletzt aber behielt der Rieſe die Oberhand[5] und ſchlug den Tod mit ſeiner Fauſt nieder, daß[6] er neben einem Steine zuſammenſank. Der Rieſe ging ſeiner Wege[7], und der Tod lag da beſiegt und zwar ſo kraftlos, daß er ſich nicht wieder erheben konnte. „Was[8] ſoll daraus werden," ſprach er, „wenn ich da in der Ecke liegen bleibe? Es ſtirbt[9] Niemand mehr auf Erden, und ſie wird ſo mit Menſchen angefüllt werden, daß ſie nicht mehr Platz haben, neben einander zu ſtehen." Indem kam ein junger Menſch des Weges[10], friſch und geſund, ſang ein Lied und warf[11] ſeine Blicke hin und her. Als er den halb Ohnmächtigen[12] erblickte, ging er mitleidig heran, richtete ihn auf, flößte[13] ihm aus ſeiner Flaſche einen ſtärkenden Trunk ein und wartete, bis er wieder zu Kräften[14] kam. „Weißt du

auch," fragte der Fremde, „wer ich bin, und wem du wieder auf die Beine[15] geholfen haſt?" „Nein," antwortete der Jüngling, „ich kenne dich nicht." „Ich bin der Tod," ſprach er, „und verſchone Niemand, kann[16] auch mit dir keine Ausnahme machen. Damit du aber ſiehſt, daß ich dankbar bin, ſo[17] verſpreche ich dir, daß ich dich nicht unverſehens überfallen, ſondern dir erſt meine Boten ſenden will[18], bevor ich komme und dich abhole."

NOTES :—

(1) entgegen—this must be taken together with ſprang; in fact, entgegenſpringen may be looked upon as a separable verb. (2) Schritt—adverbial use of the accusative. (3) Wicht—this is etymologically the same as English *wight*. (4) der Tod, in German the definite article is always used with personified abstract nouns. (5) die Oberhand behalten, *to prevail*. (6) daß, *so that*. (7) ſeiner Wege—adverbial use of the genitive, *went his ways*. (8) was . . . werden, *what is to become of it*, i.e. what is to happen? (9) ſtirbt—Present in Future sense. (10) des Weges—adverbial use of the genitive, *along*. (11) Blicke werfen, *to glance*. (12) Ohnmächtigen, an adjective used as a noun, "the half fainting man." (13) flößte . . . ein, *gave him*. (14) zu Kräften kommen, *to regain strength*. (15) auf die Beine helfen, *to help* (a person) *on to his legs*, i.e. to succour. (16) kann—the subject ich must be supplied from the preceding clause. (17) ſo is correlative to damit. (18) will—on this both the Infinitives überfallen and ſenden depend.

VOCABULARY

listen, horchen, w.
as, als.
trampling, Getrabe, s.n.
ringing, Geklirr, s.n.
armour, Waffen, w.f., plur.
give the alarm, zu den Waffen rufen.
to be a pity, Schade ſein.
defence, Verteidigung, w.f.
in the meanwhile, unterdeſſen.
bright, hell.
glancing, blitzend.
opposite, gegenüberliegend.
solitary, einzig.
guard, bewachen, w.
by and by, bald nachher.
cry, Gebell, s.n.
voice, Stimme, w.f.
clattering, Geraſſel, s.n.
river side, Ufer, s.n.1.
opposition, Widerſtand, s.m.2.
advantageous, günſtig.
follower, Begleiter, s.m.1.
increase, zunehmen, s.sep.
behold, erblicken, w.
come down, herunterkommen, s.sep.
on their part, ihrerſeits.
figure, Geſtalt, w.f.
foremost, vorderſt.
mind, ſich kümmern um, w.
plunge, ſich ſtürzen, w.

Exercise 58

So[1] he stood and listened: and by and by, as the cry of the hound came nearer, he began to hear a trampling of horses and the voices of men[2] and the ringing and clattering of armour, and then he was sure[3] the enemy[4] were coming to[5] the river side. Then the king thought, "If I go back to give my men[6] the alarm, these Galloway men will get through the ford without opposition; and that would be a pity, since it is a place[7] so advantageous to make a defence against them." He therefore sent his followers to waken his men, and remained alone on the bank of the river.

In the meanwhile, the noise and trampling of the horses increased, and the moon[8] being bright, Bruce beheld the glancing arms of about two hundred men, who came down to the opposite bank of the river. The men of Galloway, on their part, saw but[9] one solitary figure guarding[10] the ford, and the foremost[11] of them plunged into the river without[12] minding him.

NOTES :—

(1) Say, he stood so (alſo) and listened. (2) Men, Menſchen. (3) He was sure—es ward ihm zur Gewißheit. (4) The enemy; the conjunction that cannot here be omitted in German. (5) To—nach. (6) Men—Leute. (7) A place... them, say, a so advantageous place for (zur) defence is, and omit "against them." (8) The moon being bright—say, as (da) the moon shone brightly. (9) But—nur. (10) Guarding, say, who was guarding. (11) Foremost—use this adjective as a noun and omit "of them." (12) Without, ohne followed by the simple infinitive.

Key to Exercise 55

In a high domed Gothic room Faust restlessly (seated) in his armchair at his desk.

Faust: Alas, I have now thoroughly and with ardent zeal studied philosophy, law, medicine, and, to my regret, also theology. There I stand now, poor fool that I am, and am as wise as I was before. I am called Master, and even Doctor, and for ten years now I have led my pupils by the nose, up and down and hither and thither (crookedly and crosswise), and I realise (see) that we can know nothing! That wellnigh breaks (burns) my heart. True, I am cleverer than all the fops, doctors, masters, and priests; no scruples nor doubts assail (plague) me, I fear neither hell nor devil—but in return I am deprived of all joy. I do not imagine that I know anything worth knowing (proper), I do not imagine that I could teach anything that could improve or profit humanity. Nor have I either possessions or money, or worldly honour or splendour. No cur would care to live so any longer. Therefore I have taken up (devoted myself to) magic, to see whether by the power and speech of spirits many a secret may not be revealed to me, so that I no longer need with bitter labour (sweat) to teach (say) what I do not know, so that I may learn what holds the world together in its innermost parts, that I may behold all creative power and the germ of life, and no longer traffic in words.

O, light of the full moon, if only you looked on my pain for the last time! light for which I have watched many a night through at this desk: then, melancholy friend, you used to appear to me over my books and papers! Ah! could I but wander on the mountaintops in your dear light, hover round mountain caverns with spirits, move over the meadows in your misty light, and, freed from the dust (vapour) of knowledge, bathe in your dew so as to become whole.

Key to Exercise 56

Bruce ließ ſeine Leute ſich niederlegen um etwas zu ſchlafen, an einem Orte ungefähr eine halbe Meile von dem Fluß entfernt, während er ſelbſt mit zwei Begleitern hinunterging um die Furte zu bewachen durch welche der Feind notwendiger Weiſe gehen mußte ehe er den Platz erreichen konnte wo König Roberts Leute lagen. Er ſtand eine Zeitlang und ſah die Furte an, und dachte bei ſich wie leicht man den Feind daran verhindern könnte durch dieſelbe zu gehen, vorausgeſetzt, daß ſie tapfer verteidigt würde, da hörte er in der Ferne das Bellen eines Hundes, welches immer näher und näher kam. Dies war der Schweißhund, der die Spuren des Königs nach der Furte verfolgte, und die zwei hundert Männer von Galloway waren bei dem Tier und wurden von ihm geleitet. Bruce dachte erſt daran zurückzugehen um ſeine Leute zu wecken; aber dann überlegte er ſich, daß es nur ein Schäferhund ſein dürfte.

M. A. L.

GREEK.—III

Third Declension

THERE are two main groups, (1) those stems ending in a mute or liquid consonant, and (2) those ending in a vowel or diphthong.

I.—NOUNS WITH STEMS ENDING IN MUTES OR LIQUIDS

(*a*) *Masculines and Feminines*

	λαιλαπ, *hurricane.*	κορακ, *raven.*	λαρυγγ, *gullet.*
		Singular.	
Nom.	ἡ λαῖλαψ	ὁ κόραξ	ὁ λάρυγξ
Gen.	λαίλᾰπ-ος	κόρᾰκ-ος	λάρυγγ-ος
Dat.	λαίλᾰπ-ι	κόρᾰκ-ι	λάρυγγ-ι
Acc.	λαῖλαπ-α	κόρᾰκ-α	λάρυγγ-α
Voc.	λαῖλᾰψ	κόρᾰξ	λάρυγξ
		Plural.	
Nom.	λαίλᾰπ-ες	κόρᾰκ-ες	λάρυγγ-ες
Gen.	λαιλάπ-ων	κοράκ-ων	λαρύγγ-ων
Dat.	λαί̓λαψ-ι	κόρᾰξ-ι	λάρυγξ-ι
Acc.	λαί̓λᾰπ-ας	κόρᾰκ-ας	λάρυγγ-ας
Voc.	λαί̓λᾰπ-ες	κόρᾰκ-ες	λά̓ρυγγ-ες
		Dual.	
N.A.V.	λαί̓λᾰπ-ε	κόρᾰκ-ε	λά̓ρυγγ-ε
G.D.	λαιλά̓π-οιν	κορά̓κ-οιν	λαρύγγ-οιν

	λαμπαδ, *torch.*	κορυθ, *helmet.*	ορνιθ, *bird.*
		Singular.	
N.V.	ἡ λαμπά̓ς	ἡ κόρυς	ὁ ὄρνις
Gen.	λαμπά̓δ-ος	κόρῡθ-ος	ὄρνιθ-ος
Dat.	λαμπά̓δ-ι	κόρῡθ-ι	ὄρνιθ-ι
Acc.	λαμπά̓δ-α	κόρυν (or κόρῡθα)	ὄρνιν (rarely ὄρνῑθα)
		Plural.	
N.V.	λαμπά̓δ-ες	κόρυθ-ες	ὄρνιθ-ες (or ὄρνεις)
Gen.	λαμπά̓δ-ων	κορύθ-ων	ὀρνίθ-ων
Dat.	λαμπά̓-σι	κόρυ-σι	ὄρνῐ-σι
Acc.	λαμπά̓δ-ας	κόρυθ-ας	ὄρνιθ-ας (or ὄρνεις)
		Dual.	
N.A.V.	λαμπά̓δ-ε	κόρυθ-ε	ὄρνῐθ-ε
G.D.	λαμπά̓δ-οιν	κορύθ-οιν	ὀρνίθ-οιν

In the following the nominative is identical with the stem, παιάν, *pæan*, λειμών, *meadow*, and νέκταρ, *nectar*.

		Singular.	
N.V.	ὁ παιά̓ν	ὁ λειμών	τὸ νέ̓κταρ
Gen.	παιᾶν-ος	λειμῶν-ος	νέ̓κταρ-ος

Stems in -ντ drop the τ in the nominative. This applies also to adjectives but not to participles.

	λεοντ-, *lion.*	γιγαντ-, *giant.*	οδοντ-, *tooth.*
		Singular.	
Nom.	ὁ λέων	ὁ γίγᾱς	ὁ ὀδούς
Gen.	λέοντ-ος	γίγαντ-ος	ὀδόντ-ος
Dat.	λέοντ-ι	γίγαντ-ι	ὀδόντ-ι
Acc.	λέοντ-α	γίγαντ-α	ὀδόντ-α
Voc.	λέον	γίγαν	ὀδούς
		Plural.	
Nom.	λέοντ-ες	γίγαντ-ες	ὀδόντ-ες
Gen.	λεόντ-ων	γιγάντ-ων	ὀδόντ-ων
Dat.	λέου-σι	γίγα-σι	ὀδοῦ-σι
Acc.	λέοντ-ας	γίγαντ-ας	ὀδόντ-ας
Voc.		γίγαντ-ες	ὀδόντ-ες
		Dual.	
N.A.V.	λέοντ-ε	γίγαντ-ε	ὀδόντ-ε
G.D.	λεόντ-οιν	γιγάντ-οιν	ὀδόντ-οιν

The noun ὁ, ἡ, παῖς (gen. παιδός, *child*), has in the vocative παῖ.

	ποιμεν-, *shepherd.*	δαιμον-, *divinity.*	ῥῑν-, *nose.*
		Singular.	
Nom.	ὁ ποιμήν	ὁ δαίμων	ἡ ῥίς
Gen.	ποιμέν-ος	δαίμον-ος	ῥιν-ός
Dat.	ποιμέν-ι	δαίμον-ι	ῥιν-ί
Acc.	ποιμέν-α	δαίμον-α	ῥῖν-α
Voc.	ποιμήν	δαῖμον	ῥίς
		Plural.	
N.V.	ποιμέν-ες	δαίμον-ες	ῥῖν-ες
Gen.	ποιμέν-ων	δαιμόν-ων	ῥιν-ῶν
Dat.	ποιμέ-σι	δαίμο-σι	ῥι-σί
Acc.	ποιμέν-ας	δαίμον-ας	ῥῖν-ας
		Dual.	
N.A.V.	ποιμέν-ε	δαίμον-ε	ῥῖν-ε
G.D.	ποιμέν-οιν	δαιμόν-οιν	ῥιν-οῖν

	αἰθερ-, *air.*	ῥητορ-, *orator.*	θηρ, *wild beast.*	αλ-, *salt.*
		Singular.		
Nom.	ὁ αἰθήρ	ὁ ῥήτωρ	ὁ θήρ	ὁ ἅλς
Gen.	αἰθέρ-ος	ῥήτορ-ος	θηρ-ός	ἁλ-ός
Dat.	αἰθέρ-ι	ῥήτορ-ι	θηρ-ί	ἁλ-ί
Acc.	αἰθέρ-α	ῥήτορ-α	θῆρ-α	ἅλ-α
Voc.	αἰθήρ	ῥῆτορ	θήρ	ἅλς
		Plural.		
N.V.	αἰθέρ-ες	ῥήτορ-ες	θῆρ-ες	ἅλ-ες
Gen.	αἰθέρ-ων	ῥητόρ-ων	θηρ-ῶν	ἁλ-ῶν
Dat.	αἰθέρ-σι	ῥήτορ-σι	θηρ-σί	ἁλ-σί
Acc.	αἰθέρ-ας	ῥήτορ-ας	θῆρ-ας	ἅλ-ας
		Dual.		
N.A.V.	αἰθέρ-ε	ῥήτορ-ε	θῆρ-ε	ἅλ-ε
G.D.	αἰθέρ-οιν	ῥητόρ-οιν	θηρ-οῖν	ἁλ-οῖν

	πατερ-, *father.*	θυγατερ-, *daughter.*	ανερ-, *man.*
		Singular.	
Nom.	ὁ πατήρ	ἡ θυγάτηρ	ὁ ἀνήρ
Gen.	πατρ-ός	θυγατρ-ός	ἀνδρ-ός
Dat.	πατρ-ί	θυγατρ-ί	ἀνδρ-ί
Acc.	πατέρ-α	θυγατέρ-α	ἄνδρ-α
Voc.	πάτερ	θύγατερ	ἄνερ
		Plural.	
N.V.	πατέρ-ες	θυγατέρ-ες	ἄνδρ-ες
Gen.	πατέρ-ων	θυγατέρ-ων	ἀνδρ-ῶν
Dat.	πατρ-ά-σι	θυγατρ-ά-σι	ἀνδρ-ά-σι
Acc.	πατέρ-ας	θυγατέρ-ας	ἄνδρ-ας
		Dual.	
N.A.V.	πατέρ-ε	θυγατέρ-ε	ἄνδρ-ε
G.D.	πατέρ-οιν	θυγατέρ-οιν	ἀνδρ-οῖν

Similarly γαστήρ, *belly*, and μήτηρ, *mother*.

Ἀστήρ, *star*, has its dative plural in -ασι (ἄστρασι) but retains the ε in the gen. and dat sing. ἀστέρος and ἀστέρι. Δημήτηρ is declined Δήμητρος, Δήμητρι, Δήμητρα, Δήμητερ. Δαήρ, *husband's brother*, has the voc. δᾶερ. Ἀνήρ is very irregular, dropping ε always before a vowel and taking δ in its place, thus ἀνδρός for ἀνέρος and ἀνδρί for ἀνέρι.

(*b*) *Neuters.*

	σωματ-, *body.*	τερατ-, *portent.*	περατ-, *end.*
N.V.A.	τὸ σῶμα	τὸ τέρας	τὸ πέρας
Gen.	σώματ-ος	τέρατ-ος	πέρατ-ος
Dat.	σώματ-ι	τέρατ-ι	πέρατ-ι
N.V.A.	σώματ α	τέρατ-α	πέρατ-α
Gen.	σωμάτ-ων	τεράτ-ων	περάτ-ων
Dat.	σώμα-σι	τέρα-σι(ν)	πέρα-σι
N.V.A.	σώματ-ε	τέρατ-ε	πέρατ-ε
G.D.	σωμάτ-οιν	τεράτ-οιν	περάτ-οιν

Some other neuter nouns in -ας may be grouped with these. Γέρας, *prize*, stem γερασ-, is contracted when the α of the stem is followed by a vowel, thus :—

	Singular.	*Plural.*
N.A.V.	τὸ γέρας	(γέρα-α) γέρα
Gen.	(γέρα-ος) γέρως	(γερά-ων) γερῶν
Dat.	(γέρα-ι) γέρᾳ	γέρασι
	Dual.	
N.A.V.	(γέρα-ε) γέρα	
G.D.	(γερά-οιν) γερῷν	

Like γέρας may be declined τὸ γῆρας, *old age* (in the sing. only), κρέας, *flesh*, and κέρας, *wing of an army*, stem κερασ-. In Attic prose, κέρας, *horn*, is declined like τέρας, from the stem κερᾱτ-, gen. κέρᾱτος.

II.—Nouns with stems ending in Vowels or Diphthongs

Contraction is usual in this class of nouns owing to the meeting of the vowel in the stem with a vowel in the case-ending. Stems ending in ι and some in υ change these letters to ε in the oblique cases, thus :—

πολι-, *city.* πηχῠ-, *cubit.*
σιναπι, *mustard.* αστῠ, *town.*

	Singular.			
Nom.	ἡ πόλις	ὁ πῆχυς	τὸ σίναπι	τὸ ἄστυ
Gen.	πόλε-ως	πήχε-ως	σινάπε-ως	ἄστε-ος
Dat.	πόλει	πήχει	σινάπει	ἄστει
Acc.	πόλιν	πῆχυν	σίναπι	ἄστυ
Voc.	πόλι	πῆχυ	σίναπι	ἄστυ
	Plural.			
Nom.	πόλεις	πήχεις	σινάπη	ἄστη
Gen.	πόλε-ων	πήχε-ων	σινάπε-ων	ἀστέ-ων
Dat.	πόλε-σι	πήχε-σι	σινάπε-σι	ἄστε-σι
Acc.	πόλεις	πήχεις	σινάπη	ἄστη
Voc.	πόλεις	πήχεις	σινάπη	ἄστη
	Dual.			
N.A.V.	πόλ(ε-ε)η	πήχ(ε-ε)η	σινάπ(ε-ε)η	ἄστ(ε-α)η
G.D.	πολέ-οιν	πηχέ-οιν	σιναπέ-οιν	ἀστέ-οιν

Most stems ending in υ retain this unchanged, and the ῐ remains unaltered in the rare κῖς, *woodworm*.

	κῑ-, *woodworm.*	συ-, *pig.*	ἰχθῦ, *fish.*
	Singular.		
Nom	ὁ κῖς	ἡ σῦς	ὁ ἰχθύς
Gen.	κι-ός	συ-ός	ἰχθύ-ος
Dat.	κι-ί	συ-ί	ἰχθύ-ϊ
Acc.	κῖν	σῦν	ἰχθύν
Voc.	κῖ	σῦ	ἰχθύ
	Plural.		
N.V.	κῖ-ες	σύ-ες	ἰχθύ-ες
Gen.	κι-ῶν	σύ-ῶν	ἰχθύ-ων
Dat.	κι-σί	συ-σί	ἰχθύ-σι
Acc.	κῖ-ας	σύ-ας, σῦς	(ἰχθύ-ας) ἰχθῦς
	Dual.		
N.V.A.	κῖ-ε	σύ ε	ἰχθύ-ε
G.D.	κι-οῖν	συ-οῖν	ἰχθύ-οιν

Nouns with stems ending in -ευ, -αυ, or -ου are declined thus :—

βασιλευ, *king.* βου, *ox.*
γραυ, *old woman.* ναυ, *ship.*

	Singular.			
Nom.	βασιλεύς	γραῦς	βοῦς	ναῦς
Gen.	βασιλέ-ως	γρᾱ-ός	βο-ός	νεώς
Dat.	(βασιλέϊ) βασιλ-εῖ	γρᾱ-ῖ	βο-ῖ	νηί
Acc.	βασιλέ-α	γραῦν	βοῦν	ναῦν
Voc.	βασιλεῦ	γραῦ	βοῦ	ναῦ
	Plural.			
N.V.	(βασιλέες) βασιλ-εῖς or βασιλῆς	γρᾱ-ες	βό-ες	νῆες
Gen.	βασιλέ-ων	γρᾱ-ῶν	βο-ῶν	νεῶν
Dat.	βασιλεῦσι	γραυσί	βουσί	ναυσί
Acc.	βασιλέ-ας	γραῦς	βοῦς	ναῦς
	Dual.			
N.A.V.	βασιλέ-ε or βασιλῆ	γρᾱ-ε	βό-ε	νῆ-ε
G.D.	βασιλέ-οιν	γρᾱ-οῖν	βο-οῖν	νε-οῖν

Nouns with stems ending in ο or ω are declined thus :—

αιδο or αιδος, *reverence.* ἠχω, *echo.* ἡρω, *hero.*

	Singular.		*Singular.*	*Plural.*
Nom.	ἡ αἰδώς	ἡ ἠχώ	ὁ ἥρως	ἥρω-ες
Gen.	(αἰδό-ος) αἰδοῦς	(ἠχό-ος) ἠχοῦς	ἥρω-ος	ἡρώ-ων
Dat.	(αἰδό-ϊ) αἰδοῖ	(ἠχό-ϊ) ἠχοῖ	ἥρω-ι	ἥρω-σι(ν) or ἥρῳ
Acc.	(αἰδό-α) αἰδῶ	(ἠχό-α) ἠχῶ	ἥρω-α	ἥρω-ας or ἥρω
Voc.	(αἰδό-ϊ) αἰδοῖ	(ἠχό-ϊ) ἠχοῖ		ἥρως

πειθώ, *persuasion*, and a few other words are declined like αἰδώς. They have no dual or plural, and are all feminine.

Nouns with stems ending in -ης and -ος (gen.-ος) undergo contraction when a vowel follows the ε of the stem, the stem originally ending in -ες.

τριήρης, trireme, stem τριηρες, is declined thus :—

	Singular.	*Plural.*
Nom.	ἡ τριήρης	(τριήρε-ες) τριήρεις
Gen.	(τριήρε-ος) τριήρους	τριηρέ-ων and τριηρῶν
Dat.	(τριήρε-ι) τριήρει	τριήρε-σι
Acc.	(τριήρε-α) τριήρη	(τριήρε-ας) τριήρεις
Voc.	τριῆρες	(τριήρε-ες) τριήρεις
	Dual.	
N.A.V.	τριήρε-ε and τριήρη	
G.D.	τριηρέ-οιν and τριηροῖν	

Note the contraction of the dual into τριήρη, not into the usual form in ει. Proper names in

-ης (gen -ους) are declined like τριήρης, e.g., ὁ Σωκράτης, ὁ Περικλῆς. (Note the dative τῷ Περικλεῖ contracted from Περικλέει.)

Proper names ending in -ης (gen. -εος), except those in -κλέης, have also an accusative in -ην, as Σωκράτην, Δημοσθένην. Γένος, *race*, stem γενεσ-, is declined as follows:—

Singular.		*Plural.*	
N.A.V.	γένος	N.A.V.	(γένε-α) γένη
Gen.	(γένε-ος) γένους	Gen.	(γενέ-ων) γενῶν
Dat.	(γένε-ϊ) γένει	Dat.	γένε-σι

Dual.

N.A.V. (γένε-ε) γένη G.D. (γενέ-οιν) γενοῖν

Prepositions

Prepositions take the genitive, dative, or accusative case of the nouns they govern. Some prepositions may be used with all the cases, some with two and some with one only. In the following table those most used are classified according to the number of cases they may govern and the particular cases governed by them:—

One Case.	*Two Cases.*	*Three Cases.*
	Genitive.	
ἀντί, *instead of, for.*	διά, *through* (of place or time), *by means of.*	ἀμφί, *about, concerning.*
ἀπό, *from, away from.*	κατά, *down from, down upon.*	ἐπί, *upon, towards.*
ἐκ, or ἐξ, *from, out of.*	ὑπέρ, *over, above, for.*	μετά, *with.*
ἕνεκα, *on account of.*		παρά, *from, from beside.*
πρό, *before* (of place or time), *in preference to.*		περί, *concerning, about.*
		πρός, *in front of, over against, from.*
		ὑπό, *under, through, by.*
	Dative.	
ἐν, *in* (of place or time).		ἀμφί, *about* (poetic).
σύν or ξύν, *with.*		ἐπί, *upon, by.*
		μετά, *amidst* (poetic).
		παρά, *by, near.*
		περί, *around, about.*
		πρός, *at* (of rest), *in addition to.*
		ὑπό, *under* (of place).
	Accusative.	
ἀνά, *up, along, over, through.*	διά, *because of, on account of.*	ἀμφί and περί, *about, near.*
εἰς or ἐς, *into, to, within.*	κατά, *through, down, along, during.*	ἐπί, *to, towards.*
ὡς, *to* (of persons)	ὑπέρ, *over, beyond.*	μετά, *after, next to.*
		παρά, *to, near to, by the side of, on account of, beyond, except.*
		πρός, *to* (of motion), *towards.*
		ὑπό, *under* (of motion to), *towards.*

Prepositions are used with the accusative to limit the idea of motion to *towards, over*, or *along* something; with the genitive to limit the idea of origin *from* something; and with the dative to limit the idea of happening *in* a place.

NOTES ON THE CONSTRUCTION OF SENTENCES.

The pronoun is not as a rule expressed. Thus, γράφω, *I write*, implies *I*, and γράφει, *he writes*, and γράφομεν, *we write*.

The verb *to be*, as in English or Latin, takes the same case after as before. Accordingly, after the verb εἶναι, *to be*, or a passive verb, the subject and the substantive in the predicate are put in the same case. Thus, ὁ νοῦς ἐστι διδάσκαλος ἀνθρώπου, *the mind is man's instructor;* Πεισίστρατος ἀπεδείχθη ἄρχων, *Pisistratus was appointed archon;* θαυμαστὰ ταῦτα φαίνεται, *these things seem marvellous.*

Note that in sentences of this form the article is not used with the substantive in the predicate. Thus, ὁ πόλεμός ἐστιν ἀρχὴ τῶν κακῶν, *the war is the beginning of the disasters.*

VOCABULARY

ἀγήρως, -ων,	*deathless, ageless.*	θάλλω,	*I bloom, I flourish.*
ᾄδω,	*I sing.*	καλός, -ή, -όν,	*beautiful, noble.*
ἀλήθεια, ἡ,	*truth.*	λαμβάνω,	*I take.*
ἀνδρεῖος, -α, -ον,	*brave.*	μανία, ἡ,	*madness.*
ἀρετή, ἡ,	*virtue.*	νίζω,	*I wash.*
ἀριστεύω,	*I am best* or *bravest.*	παρά, (with dative)	*by, near.*
γίγνομαι,	*I become, I arise.*	Πέρσης, -ου, ὁ,	*Persian.*
δέ,	*but, on the other hand.*	πλεῖστος, -η, -ον,	*most, very many.*
δόξα, ἡ,	*glory.*	ῥώμη, ἡ,	*strength.*
Ἕλλην, ὁ,	*Greek.*	σέβομαι,	*I revere, I worship.*
ἔπαινος, -ου, ὁ,	*praise.*	Σπαρτιάτης, -ου, ὁ,	*Spartan.*
ἑραστής, -οῦ, ὁ,	*lover, friend.*	στολή, ἡ,	*dress, robe.*
Ἑρμῆς, οῦ, ὁ,	*Hermes.*	χείρ, -ός, ἡ,	*hand.*
εὔχομαι,	*I pray* (with accusative)	ψεύστης, -ου, ὁ,	*liar.*
ἐχθρός, -ά, -όν,	*hateful.*	ψῡχή, ἡ,	*breath, life, soul.*

Exercise 2

(*a*) Translate into English:—

1. Πολλοὶ παρὰ κρατηρὶ γίγνονται φίλοι, πλεῖστοι δ' ἐχθροί. 2. Οἱ τῆς δόξης ἐρασταὶ οὐ φεύγουσι. 3. Μὴ πιστεύετε τοῖς ψεύσταις. 4. Οἱ ψεῦσται τῆς ἀληθείας οὐκ εἰσὶν ἐρασταί. 5. Φεῦγε ψεύστην, ὦ Σπαρτιᾶτα. 6. Τὸν Ἑρμῆν θαυμάζω.

(*b*) Translate into Greek:—

1. Avoid (thou) the wild beasts. 2. The soldiers sing a pæan. 3. Wash your (the) hands. 4. The meadows are blooming. 5. Pray to the merciful God. 6. The Greeks worship the merciful God.

Key to Exercise 1

(*a*) 1. The lyre dissipates cares. 2. Care gnaws the heart. 3. I live pleasantly. 4. You write beautifully. 5. He fights bravely. 6. If you fight bravely, you are admired.

(*b*) 1. Φεύγετε τὴν ἀδικίαν, ὦ νεανίαι. 2. Φεύγεις τὴν ἀδικίαν. 3. Αἱ μέριμναι λύονται τῇ λύρᾳ. 4. Καλῶς γράφει. 5. Εἰ ἀληθεύω πιστεύομαι. 6. Μὴ μάχεσθε.

E. A. B.

Continued from page 167.

GEOGRAPHY:

Contributors:—Robert Finch, F.R.G.S.; W. H. Koebel; Sir John Scott-Keltie, LL.D.; Cyril J. Silverston, B.Sc.(Lond.).

AUSTRALASIA.—III

THE differences between New Zealand and Australia are so marked that it is difficult to believe that the two lands are comparatively close neighbours in the southern seas, for only twelve hundred miles separate the three islands of New Zealand from the nearest Australian point.

There is scarcely a feature, indeed, which these two countries have in common. Landscape, inhabitants, fauna, flora, climate—nothing and nobody could differ more widely from each other than the representatives of these of the one land from those of the other. For instance, there is not the faintest resemblance between the bush of Australia and the mountainous country that is typical of New Zealand, and that in so many districts bears a strong resemblance to a Swiss landscape.

No two human beings could be much further apart than the Australian aboriginal and the stalwart Maori; and the eucalyptus of the former and the evergreens of the latter present as marked a contrast as any other. But these sorts of comparisons could be continued indefinitely, and it is necessary now to turn to a survey of New Zealand alone.

New Zealand

The fact is usually insisted on that New Zealand consists of three main islands. Technically this is of course correct, although the relative importance of Stewart Island, the third, may be judged when it is explained that the total extent of this is 665 square miles, whereas the South Island has an area of 58,525 square miles, and the North Island counts 44,468 square miles.

But for a few stretches of dead-level plain, the whole of New Zealand is hilly. There are, however, three main chains of mountains which may be distinguished from the rest. In the South Island are the Southern Alps, extending from the neighbourhood of Cascade Point on the west coast to Tasman Bay, the indentation on the extreme north of the island. A couple of lesser systems in this island are the Kaikouras, rising from the back of the Canterbury Plains along the east coast to the Cook Strait, and the Tasman Mountains in the extreme north-west.

A World's Wonder

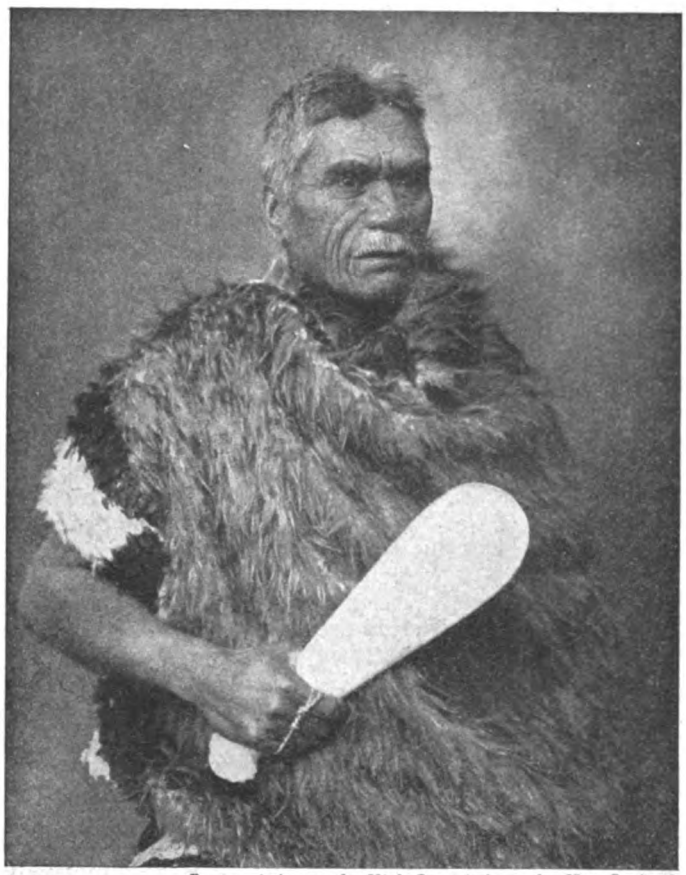
In the south-east of the North Island are the Ruahine, Tararua, Haruru, and Raukumara ranges. In this island, too, are the mineralised Coromandel Mountains and the Taupo volcanic zone. This curious region, which constitutes one of the wonders of the world, is situated more or less in the centre of the island, and its highest point is Mount Ruapehu, which attains to a height of 9,175 feet. This district is famous for its geysers, fumaroles, and hot springs, and here stood the famed pink and white terraces of Rotomahana, that were unfortunately destroyed by the eruption of Tarawera in 1886.

The greater part of New Zealand is subject to earthquakes, and Wellington and Canterbury, as well as many of the lesser towns, have suffered severely from these disturbances in the past. The wooden bungalows which dot the countryside are practically proof against seismic action; but the loftier buildings of the towns constitute a certain source of danger.

New Zealand possesses few rivers of any considerable size. On the west coast of the South Island they are little beyond mountain torrents, and on the east the sole stream of any size is the Clutha, which is navigable for a distance of only thirty miles or so, flowing into the sea to the south of Dunedin. On the west coast of the North Island the River Wanganui is famed for the beauty of its scenery. The Waikato River in this island is the largest in New Zealand. This passes through a mountainous country, and empties its waters by way of the west coast a little to the south of Auckland.

The lakes of the South Island are famous

for their beauty, and, like the deep, fjord-like sea-inlets such as Milford Sound are of a Norwegian type of landscape. Some of the chief of these southern lakes are Lake Wakatipu, Te Anau, and Manapouri. In the North Island the Lakes Rotorua, Taupo, Tarawera, and Rotomahana are met with in the volcanic region.



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A MAORI CHIEF.

Representative of a fine, stalwart native race now almost completely civilised and educated. The aboriginal inhabitants of New Zealand are in striking contrast to those of Australia.

Such plains as exist in New Zealand are singularly rich in soil. The most extensive are the Canterbury Plains in the eastern centre of the South Island. The Southland Plains in Otago are also important, as are the narrow Westland Plains on the west coast of the South Island. The North Island possesses fewer plains of note, though these exist in the neighbourhood of Wanganui, and on the east coast are lesser plain areas of great fertility such as those of Hawke Bay and Poverty Bay.

The climate of New Zealand is extremely healthy, the region of greatest heat being, of course, the north, in the extremity of which sub-tropical fruits are grown. In the far south the winters are fairly severe, and snow and ice are the ordinary features of the winter here. A certain degree of winter frost, obtains, as a matter of fact, almost up to the northernmost part of the Dominion, and the atmosphere is usually exhilarating, the most trying summer wind being that from the north. The average rainfall is heavy, exceeding 100 inches in many districts of the Southern Alps; on the Canterbury Plains, however, the rainfall averages only 15 inches.

Flora and Fauna

The New Zealand flora is remarkable for the number of its evergreen growths. There is not a single tree in the true bush, for instance, which is of a deciduous order. Magnificent timber both for cabinet and general purposes is obtained from the bush, but unfortunately the difficulties in the way of transport, there being very few rivers of an uninterrupted nature down which they can be floated, renders the handling of this difficult. There are one or two handsome flowering trees such as the Rata; but on the whole the indigenous flowers of the country are rare.

Those introduced, on the other hand, have thriven greatly, and occasionally the importation of a hardy plant such as the thistle has proved not a little disastrous, and has been the cause of much country being overrun. Typical growths of the bush are the nikau palm and the tree-fern, neither of which will consent to flourish in any real luxuriance outside the bounds of its native bush.

The variety of indigenous New Zealand animals, too, is very small. Although the wild pig abounds in many parts of the bush, this creature is only the descendant, reverted to its savage state, of some domestic pigs introduced by Captain Cook. Of native four-footed creatures not a single specimen seems to exist—unless a couple of varieties

of bat may be counted—as the rabbit, that has increased its numbers with such unwelcome enthusiasm, was, of course, introduced from England.

The birds include the kiwi—a small surviving relative of the giant Moa, now extinct—a bush crow, wood-pigeons, ducks, hawks, cormorants, a bush owl, and a rather curious dull-brown coloured parrot. The sparrow has been introduced from England, and the minah bird from India, and both of these birds have increased to an inconvenient extent.

The two principal minerals are gold and coal. The two gold centres are Otago in the south and the Thames and Coromandel fields in the north. The best coal is found in Nelson, and other deposits are met with in Otago and Auckland.

The Maoris

The origin of the Maoris, the aboriginal people of New Zealand, has never been quite satisfactorily cleared up. The most general theory prevalent among the race itself is that they came originally from a land which would seem to be the Malay peninsula.

The Maoris are a fine stalwart race, whose instincts in the past have been warlike, and who have proved themselves in their day the most formidable native fighters that the British troops have ever had to face. Their war canoes were very large and long craft, and their weapons were made of stone and bone, including a curious circular weapon, which served as an axe. Most of the old Maori customs are now practically extinct. Some of the most curious of these were the Hakas, or descriptive and war dances, and the Tangis, the elaborate funeral ceremonies and feastings.

There has never been a "colour question" between Europeans and Maoris, the fine qualities of the native race having obtained for them a perfect equality, which has been cordially acquiesced in by the New Zealanders. The survivors of the race live for the most part in the North Island, and the majority are to be met with in the King country.

The average Maori now, as a matter of fact, is completely civilised and educated, and has proved himself capable of playing his part in the professions as well as making good use of the numerous lands which he still retains.

The principal industries of New Zealand, placed in the order of their importance, are: Sheep and cattle breeding, dairy farming, gold mining, lumber, and flax. Sheep thrive particularly well in New Zealand, and some

Photo: by permission of the High Commissioner for New Zealand.

STERLING FALLS, MILFORD SOUND.

A scene in one of the many beautiful Norwegian fjord-like sea inlets in South Island, many of which are 1,500 ft. in depth.

of the pastoral land on the plains is capable of supporting five sheep to the acre all the year round, a very high figure for this industry. To what extent sheep farming has progressed will be evident from the fact that, whereas in 1861 7,856,000 lbs. of wool, valued at £523,728, were exported, the corresponding figures for 1911 were 169,000,000 lbs. and £7,400,000. The amount of frozen meat, moreover, shipped in the latter year, much the greater part of which was mutton, made a total of some four and a quarter million pounds.

Cattle breeding comes second in importance. The totals of the butter and cheese exports for the same year amounted to over two and a half million pounds, and this makes a sufficiently brave showing.

The timber industry combined with that of the kauri gum, only amounts to about a third of the financial importance of the dairying. Auckland Province is the field of the kauri gum, which is found in the ground, having exuded from the great kauri trees in the past. This "gum-digging" is one of the staple occupations of the north.

New Zealand flax is famous for its quality, and this plant flourishes wild in the more open spaces, especially of the North Island.

Towns and Harbours

The capital and chief port of New Zealand is Wellington (pop., 95,000), on the Cook Strait, at the point nearest to the South Island. Wellington possesses a harbour which not only affords a magnificent anchorage, but is very beautiful at the same time. The first Parliament House here, now burned down, was held to be the largest wooden building in the world.

Auckland, on a narrow isthmus in the north of North Island, is the largest town in New Zealand, possessing 130,000 inhabitants. This important northern centre resembles Wellington in that its harbour is not only admirably adapted to a great trading city, but is one of the beauty spots of Australasia.

Dunedin is the chief town of the South Island, and has a population of nearly 70,000. Its harbour, Port Chalmers, cannot stand comparison with the two previously referred to, but it affords good shelter, and has now been dredged so as to admit the large liners. Dunedin is one of the chief Scottish centres of the South Island.

Christchurch, situated on the central east coast, is the largest city in the South Island, having a population of about 93,000. With the great Canterbury Plains at its back, it is an important commercial city. It is, moreover, a cathedral town, and one of the principal social centres of the country. Its port is Lyttelton, distant seven miles from the main city.

Other towns of importance are Invercargill in the far south; Nelson, another South Island town, on the Cook Strait; and Greymouth, tapping a mineral district on the west coast of the same island. Wanganui, in the south-west of the North Island, is the centre of a famous dairy-farming district. Napier, on the east coast of the North Island, is the port for the rich Hawke Bay district, while Gisborne, to the north of this, is a rapidly increasing town.

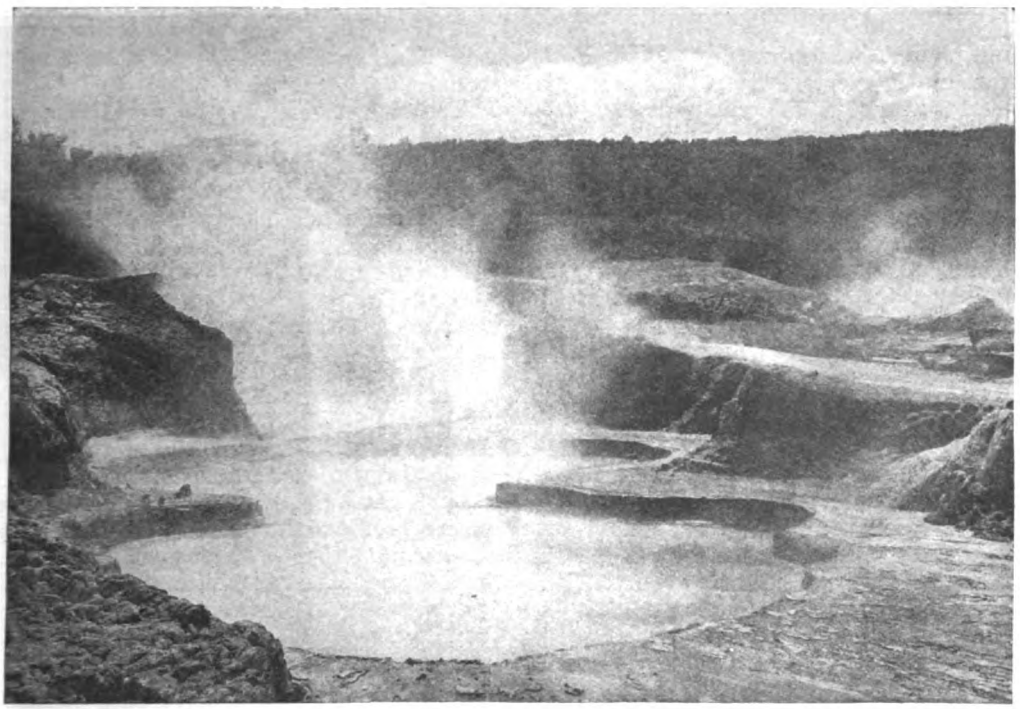
Considerable strides have been made in the railway development of New Zealand, the total mileage being over 3,000. In South Island the main line strikes coastwise from Christchurch to Dunedin and Invercargill. In the North Island the chief railway centre is Wellington, from which lines radiate to the west and east coast. A very efficient steamer service connects the various ports.

New Guinea

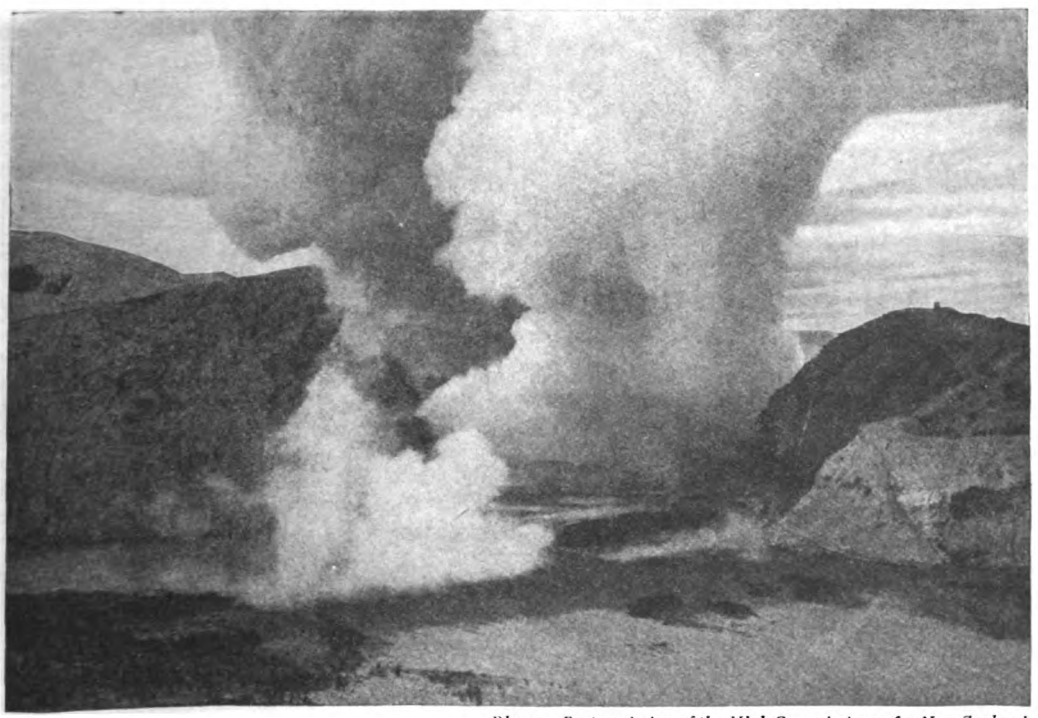
New Guinea is the remaining large island of Australasia. This is situated just to the north of Australia, its nearest point being separated from the continent by the Torres Strait. Granting Australia the status of a continent, which is now usual, New Guinea is the largest island in the world, having an area of 235,000 square miles. Of this area 90,540 square miles belong to Great Britain, and this part is known as Papua. A certain amount of German colonisation has been carried on in the island, but this, of course, has now come permanently to an end.

New Guinea presents many points of extreme interest. It is a land of magnificent vegetation, brilliant birds, and very strange human beings. Although much of its territory is volcanic, the country does not appear to suffer much from actual eruption. In speaking of its territories, however, it must be remembered that the greater part has yet to be explored. It is certain that the land, as a whole, is very mountainous, and the highest peaks of the Snow Mountains reach the imposing altitude of 17,000 feet and more.

The principal river is the Fly River, which drains a large area of western Papua, and that flows into the Gulf of Papua. Other important streams are the Kikor and the Amberno, while in the west are the Ramu and the Kaiserin Augusta. Some of the



One of the most remarkable of geysers, the so-called Hell's Gates, the boiling spring at Tikitere, Rotorua.



Photos. By permission of the High Commissioner for New Zealand.

Steam clouds arising from Waimangu, another of these active boiling water springs.

SCENES IN NEW ZEALAND'S VOLCANIC WONDERLAND.

inland mountain streams are difficult to follow, as they occasionally disappear into natural tunnels in the midst of the deep gorges, and pass underground for some distance before emerging.

The New Guinea jungle is extraordinarily dense, and the luxuriance of the growth in the coastal lowlands is the natural result of a damp and tropical heat. The sago palm abounds in this coastal region, and is the principal food of the natives. Coffee, rubber, coco-nuts, and sisal hemp are cultivated, as well as yams, or sweet potatoes, sugar-cane, bananas, ginger, and fruits such as the pineapple, orange, and passion fruit.

Harmless Animals and—

Although few mammals are met with (the wallaby, small tree kangaroo, spiny ant-eater, and a few species of mice being the sole representatives known to exist), the variety of the bird life makes up for this deficiency. Many of these—including an extraordinary number of species of birds of paradise—are of wonderful brilliancy. Other notable kinds are cassowaries, kingfishers, parrots, pigeons, and the bower-bird, which has the amazing habit of decorating its premises with flowers!

The New Guinea reptile world is a well-populated one, counting among its innumerable denizens crocodiles, lizards, tortoises, snakes, land-leeches, mosquitoes, sandflies, and a multitude of similar pests without which no especially luxuriant vegetation would seem able to exist in any part of the world. Some of the butterflies, moreover, are among the most gorgeous that are known.

Wild Men

The Papuans and the rest of the inhabitants of the island are a warlike folk that number cannibalism and head hunting among their favourite occupations. To such an extent have these fierce and bloodthirsty people been accustomed to raid each other's settlements, that no village is built unless in a strong defensive position, very often on rocky points to which access can only be had by ladders. Similarly, for defensive purposes, houses are perched on trees. The decorations of these savages are very elaborate, and their feather headgear is frequently many feet in height. W. H. K.

Photo: Underwood and Underwood.

A NEW GUINEA VILLAGE.

So fierce and bloodthirsty are the native inhabitants that no village is built except in a strong defensive position; even so, houses are often perched on trees.

Continued from page 174.

MATHEMATICS:

Contributor: — ARITHMETIC, ALGEBRA, GEOMETRY, CO-ORDINATE GEOMETRY, TRIGONOMETRY, MECHANICS, MENSURATION, ETC.
(M. A. Lewenz, M.A.[Lond.]).

ALGEBRA.—XXVII

157. Binomial Theorem; proof for any integral fractional or negative index.

When n is a positive integer, we know that

$$(a+x)^n = a^n + na^{n-1}x + \ldots + \frac{n(n-1)\ldots(n-r+1)}{r!}a^{n-r}x^r + \ldots + x^n$$

and the series stops there.

If we divide right through by a^n we have

$$\left(1+\frac{x}{a}\right)^n = 1 + n\left(\frac{x}{a}\right) + \ldots + \frac{n(n-1)\ldots(n-r+1)}{r!}\left(\frac{x}{a}\right)^r + \ldots + \left(\frac{x}{a}\right)^n$$

The series ends here and contains only the ratio $\frac{x}{a}$ and not x and a separately. We shall consequently lose nothing in generality if we put $a = 1$ and consider only the series

$$(1+x)^n = 1 + nx + \ldots + \frac{n(n-1)\ldots(n-r+1)}{r!}x^r + \ldots + x^n.$$

Note that if we put $r = n$ in the general term T_{r+1} we get $T_{n+1} = x^n$. If $r > n$, the numerator contains a vanishing factor $\therefore$ all terms after the $(n+1)$th vanish.

Suppose now that n is not a positive integer, and we consider the series of which the general term $T_{r+1} = \frac{n(n-1)\ldots(n-r+1)}{r!}x^r$

This series will be

$$1 + nx + \frac{n(n-1)}{2!}x^2 + \ldots + \frac{n(n-1)(\ldots)n-r+1)}{r!}x^r + \ldots$$

and will be finite since we cannot put $r = n$.

We have proved (§ 153) that this series is absolutely convergent if $|x| < 1$, i.e. if $-1 < x < +1$.

The value of the series clearly depends on n and x, or as it is generally expressed, is a **function** of n and x. It will be sufficient if we denote it by $f(n)$, which is read "function n," and n is called the argument. For convenience we will adopt the notation used in Vandermonde's Theorem.

$$f(n) = n_0^{(1)} + \frac{n_1}{1}x + \frac{n_2}{2!}x^2 + \ldots + \frac{n_r}{r!}x^r + \ldots$$

(1) Remember that n_0 is taken = 1.

$$f(s) = s_0 + \frac{s_1}{1}x + \frac{s_2}{2!}x^2 + \ldots + \frac{s_r}{r!}x^r + \ldots$$

By § 156 we may multiply these.

$$f(n) \times f(s) = n_0s_0 + x(n_0s_1 + n_1s_0) + \frac{x^2}{2!}(n_0s_2 + 2n_1s_1 + n_2s_0) + \ldots$$

$$\ldots + x^r\left(\frac{n_0s_r}{r!} + \frac{n_1}{1}\frac{s_{r-1}}{(r-1)!} + \frac{n_2}{2!}\frac{s_{r-2}}{(r-2)!} + \ldots\ldots\right.$$

$$\left.\ldots + \frac{n_p}{p!}\frac{s_{r-p}}{(r-p)!} + \ldots + \frac{n_rs_0}{r!}\right) + \ldots$$

The coefficient of x^r in this is

$$\frac{1}{r!}\left(s_r + \frac{r!}{1(r-1)!}n_1s_{r-1} + \ldots + \frac{r!}{p!(r-p)!}n_ps_{r-p} + \ldots + n_r\right).$$

Now $\frac{r!}{p!(r-p)!} = {}_rC_p$. Hence this coefficient may be written $\frac{1}{r!}(s_r + {}_rC_1\,n_1\,s_{r-1} + \ldots + {}_rC_p\,n_p\,s_{r-p} + \ldots + n_r)$

$= \frac{(s+n)_r}{r!}$ by Vandermonde's Theorem.

$$\therefore f(n) \times f(s) = 1 + (n+s)_1x + \frac{(n+s)_2}{2!}x^2 + \ldots + \frac{(n+s)_r}{r!}x^r + \ldots$$

i.e. $f(n) \times f(s) = f(n+s)$ (I).

To find the value of $f(0)$, put $n = 0$.

Then $f(0) = 1 + 0x + 0x^2 + \ldots + 0x^r + \ldots\ldots = 1$

i.e. $f(0) = 1$ (II).

Similarly $f(1) = 1 + x + 0x^2 + \ldots\ldots + 0x^r + \ldots = 1 + x$

i.e. $f(1) = 1 + x$ (III).

And $f(n)$, where n is a positive integer,

$$= 1 + n_1x + \frac{n_2}{2!}x^2 + \ldots\frac{n_r}{r!}x^r + \ldots + x^n + 0x^{n+1} + 0x^{n+2} + \ldots$$

i.e. $f(n) = (1+x)^n$ where n is a positive integer (IV).

By repeated applications of I

$$f(n) \times f(p) \times f(q) \times f(s) \times \ldots\ldots = f(n+p+q+s+\ldots)$$ (V).

and I and V are true for all values of n, p, q, s . . . . . .

Let l and m be 2 positive integers. Then by V

$f\left(\frac{l}{m}\right) \times f\left(\frac{l}{m}\right) \times f\left(\frac{l}{m}\right)$ . . . to m factors

$= f\left(\frac{l}{m} + \frac{l}{m} + \text{. . . . to } m \text{ term}\right)$

$\therefore \left[f\left(\frac{l}{m}\right)\right]^m = f(l) = (1+x)^l$ $\because$ l is a positive integer.

Hence $f\left(\frac{l}{m}\right)$ is an mth root of $(1+x)^l$

$\therefore f\left(\frac{l}{m}\right) = (1+x)^{\frac{l}{m}}$.

Thus we see IV is true where n is any positive commensurable fraction.

Now let n be negative and in I put $s = -n$ then $f(n) \times f(-n) = f(n-n) = f(0) = 1$ by II.

$\therefore f(n) = \frac{1}{f(-n)}$

$\because$ n is negative $\therefore$ $(-n)$ is positive.

$\therefore$ by IV $f(-n) = (1+x)^{-n}$

$\therefore f(n) = \frac{1}{(1+x)^{-n}} = (1+x)^n$

Thus we see IV is true when n is negative, and $\therefore$ for all values of n

$$1 + nx + \frac{n(n-1)}{2!}x^2 + \ldots + \frac{n(n-1) + \ldots (n-r+1)}{r!}x^r + \ldots = (1+x)^n$$

provided $-1 < x < 1$.

158. *The general term in the expansion of* $(1-x)^{-n}$ *in its simplest form.*

$$\frac{T_{r+1}}{} = \frac{(-n)(-n-1)(-n-2)\ldots(-n-r+1)}{r!}(-x)^r$$

$$= (-1)^r \frac{n(n+1)(n+2)\ldots(n+r-1)}{r!}(-1)^r x^r$$

$$= \frac{(-1)^{2r}\, n(n+1)(n+2)\ldots(n+r-1)}{r!}x^r$$

$$= \frac{n(n+1)(n+2)\ldots(n+r-1)}{r!}x^r.$$

From this it is clear that every term in $(1-x)^{-n}$ is positive. The student will find it convenient to use this form of the general term in the case of negative indices.

159. To find the greatest term in the expansion of $(a+x)^n$ by means of the binomial series.

$\frac{T_{r+1}}{T_r} = \frac{n-r+1}{r}\frac{x}{a}$; hence each term can be derived from the preceding one by multiplying by the factor $\frac{n-r+1}{r}\frac{x}{a}$.

When the **numerical** value of this factor is > 1, each term is greater than the preceding one.

Case I n is a positive integer.

The series ends and r can have any value 1, 2, 3 . . . . . n.

$\therefore \frac{n-r+1}{r}$ is always > 0.

If x and a have opposite signs $\frac{x}{a} < 0$, we shall therefore consider the numerical value of $\frac{x}{a}$ i.e. $\left|\frac{x}{a}\right|$

$$\left|\frac{T_{r+1}}{T_r}\right| = \frac{n-r+1}{r}\left|\frac{x}{a}\right|$$

$\therefore T_{r+1} \gtreqless T_r$ according as $\frac{n-r+1}{r}\left|\frac{x}{a}\right| \gtreqless 1$;

i.e. $(n-r+1)\left|\frac{x}{a}\right| \gtreqless r$; i.e $(n+1)\left|\frac{x}{a}\right| \gtreqless r\left(1 + \left|\frac{x}{a}\right|\right)$;

i.e. $\frac{(n+1)\left|\frac{x}{a}\right|}{1+\left|\frac{x}{a}\right|} \gtreqless r$.

Case II. n not a positive integer.

$\frac{T_{r+1}}{T_r} = \frac{n-r+1}{r}\frac{x}{a} = \left\{\frac{n+1}{r} - 1\right\}\frac{x}{a}$.

If $n+1 > 1$, then $\because$ r may be 1, 2 . . . . . it is possible to have $\frac{n+1}{r} > 1$. Hence if $n > 0$ in considering the sign of $\left(\frac{n+1}{r} - 1\right)$ we must take 2 cases:

(a) terms for which $r < n+1$, (b) terms for which $r > n+1$.

(a) $r < n+1$ then $\frac{n+1}{r} - 1 > 0$

$\therefore \left|\frac{T_{r+1}}{T_r}\right| = \left(\frac{n+1}{r} - 1\right)\left|\frac{x}{a}\right|$ and this is the same as case I.

(b) $r > n+1$ then $\frac{n+1}{r} - 1 < 0$

$\left|\frac{T_{r+1}}{T_r}\right| = \left(1 - \frac{n+1}{r}\right)\left|\frac{x}{a}\right|$

$\therefore T_{r+1} \gtreqless T_r$ according as $\left(1 - \frac{n+1}{r}\right)\left|\frac{x}{a}\right| \gtreqless 1$

i.e. as $r\left\{\left|\frac{x}{a}\right| - 1\right\} \gtreqless (n+1)\left|\frac{x}{a}\right|$.

Now if $|x| < |a|$, the left-hand side is < 0 and right-hand side is > 0

$\because$ $n > 0$.

Hence $r\left\{\left|\frac{x}{a}\right| - 1\right\} < (n+1)\left|\frac{x}{a}\right|$ (algebraically)

$\therefore |T_{r+1}| < |T_r|$.

This is true for all terms for which $r > n+1$.

$\therefore$ the greatest term will be found among those considered under case (a).

The same holds good if $|x| = |a|$.

But if $|x| > |a|$, then the condition found gives $r \gtreqless \left\{\frac{(n+1)\left|\frac{x}{a}\right|}{\left\{\left|\frac{x}{a}\right| - 1\right\}}\right\}$ and by taking r large

enough we can always make $r > \dfrac{(n+1)\left|\frac{x}{a}\right|}{\left\{\left|\frac{x}{a}\right|-1\right\}}$ and $\therefore |T_{r+1}| > |T_r|$. This is the case when the series is divergent.

Example:—

To find the greatest term in $(100 + 101)^{\frac{101}{100}}$.

Here $\dfrac{T_{r+1}}{T_r} = \dfrac{\frac{111}{10} - r}{r} \cdot \dfrac{101}{100}$.

Case (a)

$r = 1, 2, 3 \ldots\ldots 11$

$\left|T_{r+1}\right| \gtreqless \left|T_r\right|$ according as $\dfrac{\frac{111}{10} - r}{r} \cdot \dfrac{101}{100} \gtreqless 1$

i.e. $\dfrac{11211}{2010} \gtreqless r$ i.e. $5\dfrac{1161}{2010} \gtreqless r$

$r = 1, 5\dfrac{1161}{2010} > r \therefore |T_2| > |T_1|$

$r = 2, \quad,, \quad,, \quad \therefore |T_3| > |T_2|$

$r = 3 \ldots\ldots\ldots\ldots$

$r = 4 \ldots\ldots\ldots\ldots$

$r = 5, 5\dfrac{1161}{2010} > r \therefore |T_6| > |T_5|$

$r = 6, 5\dfrac{1161}{2010} < r \therefore |T_7| < |T_6|$

$r = 7 \ldots\ldots\ldots\ldots$

$\ldots\ldots\ldots\ldots$

$\ldots\ldots\ldots\ldots$

$r = 11, 5\dfrac{1161}{2010} < r \therefore |T_{12}| < |T_{11}|$

Case (b)

$r = 12, 13, 14 \ldots\ldots$

Here $\left|\dfrac{T_{r+1}}{T_r}\right| = \dfrac{r - \frac{111}{10}}{r} \cdot \dfrac{101}{100}$

$\therefore \left|T_{r+1}\right| \gtreqless \left|T_r\right|$ according as $\dfrac{r - \frac{111}{10}}{r} \cdot \dfrac{101}{100} \gtreqless 1$

i.e. $r \gtreqless \dfrac{11211}{10}$ i.e. $r \gtreqless 1121\dfrac{1}{10}$

$r = 12, r < 1121\dfrac{1}{10} \therefore |T_{13}| < |T_{12}|$

$r = 13 \ldots\ldots\ldots$

$\ldots\ldots\ldots$

$\ldots\ldots\ldots$

$\ldots\ldots\ldots$

$r = 1121, r < 1121\dfrac{1}{10} \therefore |T_{1122}| < |T_{1121}|$

$r = 1122, r > 1121\dfrac{1}{10} \therefore |T_{1123}| > |T_{1122}|$

$r = 1123 \ldots\ldots\ldots$

$\ldots\ldots\ldots$

$\ldots\ldots\ldots$

$\ldots\ldots\ldots$

Now we have considered the whole series and we find

$|T_1| < |T_2| < \ldots\ldots < |T_5| < |T_6| > |T_7| > |T_8| > \ldots\ldots > |T_{12}| > |T_{13}|$

$\ldots\ldots\ldots > |T_{1121}| > |T_{1122}| < |T_{1123}| < \ldots$

Hence the terms rise to T_6 then fall to T_{1122} and afterwards rise.

Case III. $n < 0$

$\dfrac{T_{r+1}}{T_r} = \dfrac{n - r + 1}{r} \cdot \dfrac{x}{a} = \left(-1 + \dfrac{n+1}{r}\right)\dfrac{x}{a}$

$\because n < 0$, $n + 1$, if positive, is a positive proper fraction.

$\therefore \dfrac{n+1}{r}$ may be negative or a positive proper fraction.

In either case $-1 + \dfrac{n+1}{r}$ is negative

$\therefore \left|\dfrac{T_{r+1}}{T_r}\right| = \left(1 - \dfrac{n+1}{r}\right)\left|\dfrac{x}{a}\right|$

$\therefore \left|T_{r+1}\right| \gtreqless \left|T_r\right|$ according as $\left(1 - \dfrac{n+1}{r}\right)\left|\dfrac{x}{a}\right| \gtreqless 1$ i.e. $r\left\{\left|\dfrac{x}{a}\right| - 1\right\} \gtreqless (n+1)\left|\dfrac{x}{a}\right|$.

Here we have 3 cases: (*d*) $n + 1 > 0$, (*e*) $n + 1 = 0$, (*f*) $n + 1 < 0$.

And each of these have 3 sub cases: ( ) $|x| > |a|$, (ii) $|x| = |a|$, (iii) $|x| < |a|$.

(i) If $|x| > |a|$, we can write the condition

$r \gtreqless \dfrac{(n+1)\left|\frac{x}{a}\right|}{\left\{\left|\frac{x}{a}\right| - 1\right\}}$

This holds for (*d*), (*e*) and (*f*).

(2) $|x| = |a|$, the condition becomes $0 \gtreqless (n+1)\left|\dfrac{x}{a}\right|$.

In case (*d*) $n + 1 > 0 \quad \therefore 0 < (n+1)\left|\dfrac{x}{a}\right|$.

$\therefore T_{r+1} < T_r \therefore$ terms diminish from the beginning.

(*e*) $n + 1 = 0$, then $0 = 0 \therefore$ all terms are numerically equal.

(*b*) $n + 1 < 0$, then $0 > (n+1)\left|\dfrac{x}{a}\right| \therefore T_{r+1} > T_r$

$\therefore$ the terms increase from the beginning.

(3) $|x| < |a|$. After dividing by the negative divisor $\left\{\left|\dfrac{x}{a}\right| - 1\right\}$ the condition becomes

$r \lesseqgtr \dfrac{(n+1)\left|\frac{x}{a}\right|}{\left|\frac{x}{a}\right| - 1}$.

(*d*) and (*e*), $n + 1 \geqq 0$, then $\dfrac{(n+1)\left|\frac{x}{a}\right|}{\left|\frac{x}{a}\right| - 1} \leqq 0$

$$\therefore\ r > \frac{(n+1)\left|\frac{x}{a}\right|}{\left|\frac{x}{a}\right| - 1} \qquad \therefore\ |T_{r+1}| < |T_r|$$

$\therefore$ the terms diminish from the beginning.

(*f*) $n + 1 < 0$ then $|T_{r+1}| \gtreqless |T_r|$ according

as $r \gtreqless \dfrac{(-n-1)\left|\frac{x}{a}\right|}{1 - \left|\frac{x}{a}\right|}$

The right-hand side of the last is positive and ultimately r must be greater than the right-hand side $\therefore$ ultimately $T_{r+1} < T_r$ and the terms diminish.

Exercise 37

Find the general term in the expansion of:

(1) $(1-x)^{-3}$. (2) $(1+x)^{-\frac{2}{3}}$. (3) $(1+x)^{\frac{2}{3}}$. (4) $(1-5x)^{-\frac{3}{5}}$. (5) $(a^2 - 2ax)^{\frac{5}{2}}$.

M. A. L.

TRIGONOMETRY.—II

14. *To find the limits between which the trigonometrical ratios of an acute angle lie.*

Let X O Y be any acute angle α. From any point P in either bounding line draw P M perpendicular to the other bounding line.

$\because$ P M O is a right angle $\therefore$ P M O is not less than either of the angles P O M, M P O

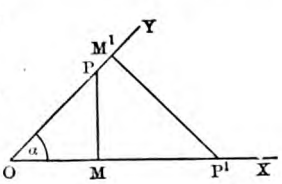
$\therefore$ side O P is never less than side O M or side P M

$\therefore \frac{P\,M}{O\,P}$ is never greater than unity

and $\frac{O\,M}{O\,P}$ is never greater than unity

whereas $\frac{O\,P}{P\,M}$ is never less than unity

and $\frac{O\,P}{O\,M}$ is never less than unity.



Hence the cosine and the sine of any acute angle α are never greater than unity; and the secant and cosecant are never less than unity.

Now if O X and O Y move together so that α becomes zero, then in the limit P M becomes zero

$\therefore \frac{P\,M}{O\,P}$ becomes zero and $\frac{O\,P}{P\,M}$ becomes infinity.

Again when α becomes zero, in the limit O M becomes equal to O P

$\therefore \frac{O\,M}{O\,P}$ becomes 1 and $\frac{O\,P}{O\,M}$ becomes 1.

$\therefore$ when $\alpha = 0°$ $\sin\alpha = 0$, $\cos\alpha = 1$, $\operatorname{cosec}\alpha = \infty$, $\sec\alpha = 1$ } and consequently $\tan\alpha = 0$, $\cot\alpha = \infty$

But if O X and O Y move apart so that α becomes 90°, then in the limit P M becomes equal to O P

$\therefore \frac{P\,M}{O\,P}$ becomes 1 and $\frac{O\,P}{O\,M}$ becomes 1.

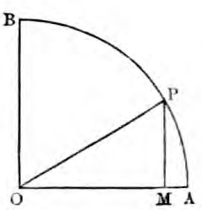
Again when α becomes 90°, in the limit O M becomes zero

$\therefore \frac{O\,M}{O\,P}$ becomes zero and $\frac{O\,P}{O\,M}$ becomes infinity

$\therefore$ when $\alpha = 90°$ $\sin\alpha = 1$, $\cos\alpha = 0$, $\operatorname{cosec}\alpha = 1$, $\sec\alpha = \infty$ } consequently $\tan\alpha = \infty$, $\cot\alpha = 0$

Hence the values of the sine and cosine of an acute angle lie between 0 and 1; the values of the tangent and cotangent lie between 0 and ∞, and the values of the secant and cosecant lie between 1 and ∞.

15. *To trace the changes in the trigonometrical ratios of an angle as the angle increases from 0° to 90°.*



Let A O B be a quadrant of a circle, O A, O B the bounding radii, and let radius O P, starting from position O A revolve counter-clockwise till it reaches the position O B. Then the $\angle$ A O P increases from 0° to 90°.

Draw P M perpendicular to O A.

As $\angle$ A O P increases from 0° to 90°, O M decreases from O A to zero and P M increases from zero to O B or O A.

$\therefore$ as $\angle$ A O P increases from 0° to 90°
cos A O P decreases from 1 to 0
sin A O P increases from 0 to 1
tan A O P increases from 0 to ∞
sec A O P increases from 1 to ∞
cosec A O P decreases from ∞ to 1
cot A O P decreases from ∞ to 0.

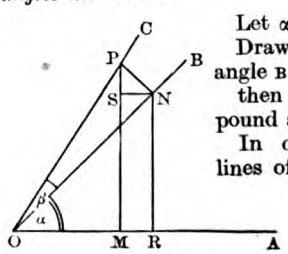
Exercise 2

(1) Trace the changes in tan α as α increases from 0° to 45°. (2) Trace the changes in cosec α as α diminishes from 90° to 0°. (3) Draw an angle whose cosine is $\frac{1}{2}$.

16. Trigonometrical ratios of compound angles.

For the present we suppose all angles to be acute.

17. *To express the cosine and sine of the sum of two angles in terms of the cosines and sines of the angles themselves.*



Let α and β be the angles.

Draw angle A O B = α and angle B O C = β

then angle A O C = compound angle $\alpha + \beta$

In one of the bounding lines of the compound angle, say O C, take any point P.

Draw P M, P N perpendicular to O A, O B respectively, and N R, N S perpendicular to O A, P M respectively.

Then in triangle P N S, the angle N P S = α, for angle N P S = 90° — P N S ∵ N S P is a right angle.

But P N O is a right angle ∴ angle S N O = 90° — P N S ∴ N P S = S N O.

Now S N and O A are parallel since both are perpendicular to S M.

∴ angle S N O = alternate angle N O A = α

∴ ∠ N P S = α

Now $\cos(\alpha+\beta) = \cos \text{M O P} = \frac{\text{O M}}{\text{O P}} = \frac{\text{O R} - \text{M R}}{\text{O P}}$

$= \frac{\text{O R} - \text{S N}}{\text{O P}} = \frac{\text{O R}}{\text{O P}} - \frac{\text{S N}}{\text{O P}} = \frac{\text{O R}}{\text{O N}} \cdot \frac{\text{O N}}{\text{O P}} - \frac{\text{S N}}{\text{P N}} \cdot \frac{\text{P N}}{\text{O P}}$

Now $\frac{\text{O R}}{\text{O N}} = \cos\alpha$, $\frac{\text{O N}}{\text{O P}} = \cos\beta$, $\frac{\text{S N}}{\text{P N}} = \sin \text{N P S} = \sin\alpha$, $\frac{\text{P N}}{\text{O P}} = \sin\beta$

∴ $\cos(\alpha+\beta) = \cos\alpha \cdot \cos\beta - \sin\alpha \cdot \sin\beta$.

Again $\sin(\alpha+\beta) = \frac{\text{P M}}{\text{O P}} = \frac{\text{M S} + \text{S P}}{\text{O P}}$

$\frac{\text{N R} + \text{S P}}{\text{O P}} = \frac{\text{N R}}{\text{O N}} \cdot \frac{\text{O N}}{\text{O P}} + \frac{\text{S P}}{\text{P N}} \cdot \frac{\text{P N}}{\text{O P}} =$

$\sin\alpha \cdot \cos\beta + \cos\alpha \cdot \sin\beta$.

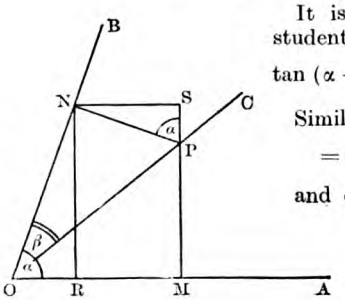
18. *To express the cosine and the sine of the difference of two angles in terms of the cosines and the sines of the angles themselves.*

Let α and β be the angles.

Draw A O B = α, and B O C = β

then A O C = compound angle $\alpha - \beta$.

In O C, one of the bounding lines of the compound angle, take any point P. Draw P M, P N perpendicular to O A, O B respectively, and N R, N S perpendicular to O A and M P produced respectively.



Then angle N P S = α, for ∠ N P S = 90° — ∠ P N S = ∠ S N B = interior and opposite angle ∠ A O B (since S N is parallel to O A) = α.

Now $\cos(\alpha-\beta) = \cos \text{A O C} = \frac{\text{O M}}{\text{O P}} = \frac{\text{O R} + \text{R M}}{\text{O P}}$

$= \frac{\text{O R} + \text{N S}}{\text{O P}} = \frac{\text{O R}}{\text{O N}} \cdot \frac{\text{O N}}{\text{O P}} + \frac{\text{N S}}{\text{P N}} \cdot \frac{\text{P N}}{\text{O P}} = \cos\alpha \cdot \cos\beta + \sin\alpha \cdot \sin\beta$.

Again $\sin(\alpha-\beta) = \frac{\text{P M}}{\text{O P}} = \frac{\text{S M} - \text{S P}}{\text{O P}} =$

$\frac{\text{N R} - \text{S P}}{\text{O P}} = \frac{\text{N R}}{\text{O N}} \cdot \frac{\text{O N}}{\text{O P}} - \frac{\text{S P}}{\text{P N}} \cdot \frac{\text{P N}}{\text{O P}} = \sin\alpha \cdot \cos\beta - \cos\alpha \cdot \sin\beta$.

19. *To express the tangent of the sum and the difference of two angles in terms of the tangents of the angles themselves.*

Let the given angles be α and β.

Algebraic Proof.

Then $\tan(\alpha+\beta) = \frac{\sin(\alpha+\beta)}{\cos(\alpha+\beta)}$

$= \frac{\sin\alpha \cdot \cos\beta + \cos\alpha \cdot \sin\beta}{\cos\alpha \cdot \cos\beta - \sin\alpha \cdot \sin\beta}$

Dividing numerator and denominator by $\cos\alpha \cdot \cos\beta$ we have

$\tan(\alpha+\beta) = \frac{\frac{\sin\alpha}{\cos\alpha} + \frac{\sin\beta}{\cos\beta}}{1 - \frac{\sin\alpha \cdot \sin\beta}{\cos\alpha \cdot \cos\beta}} = \frac{\tan\alpha + \tan\beta}{1 - \tan\alpha \cdot \tan\beta}$

Again $\tan(\alpha-\beta) = \frac{\sin(\alpha-\beta)}{\cos(\alpha-\beta)}$

$= \frac{\sin\alpha \cdot \cos\beta - \cos\alpha \cdot \sin\beta}{\cos\alpha \cdot \cos\beta + \sin\alpha \cdot \sin\beta}$

(dividing by $\cos\alpha \cdot \cos\beta$) $= \frac{\tan\alpha - \tan\beta}{1 + \tan\alpha \cdot \tan\beta}$

Geometric Proof.—See figure in § 17.

$\tan(\alpha+\beta) = \frac{\text{P M}}{\text{O M}} = \frac{\text{M S} + \text{S P}}{\text{O R} - \text{M R}} = \frac{\text{R N} + \text{S P}}{\text{O R} - \text{S N}}$

$= \frac{\frac{\text{R N}}{\text{O R}} + \frac{\text{S P}}{\text{O R}}}{1 - \frac{\text{S N}}{\text{O R}}}$, $\frac{\frac{\text{R N}}{\text{O R}} + \frac{\text{S P}}{\text{O R}}}{1 - \frac{\text{S N}}{\text{S P}} \cdot \frac{\text{S P}}{\text{O R}}}$

Now triangles N P S and N O R are similar, for ∠ N P S = α = ∠ N O R, and ∠ N S P = ∠ N R O = 90°

∴ $\frac{\text{S P}}{\text{O R}} = \frac{\text{P N}}{\text{O N}} = \tan\beta$

∴ $\tan(\alpha+\beta) = \frac{\tan\alpha + \tan\beta}{1 - \tan\alpha \cdot \tan\beta}$

It is left as an exercise for the student to prove geometrically that

$\tan(\alpha-\beta) = \frac{\tan\alpha - \tan\beta}{1 + \tan\alpha \cdot \tan\beta}$

Similarly $\cot(\alpha+\beta) = \frac{\cot\alpha \cdot \cot\beta - 1}{\cot\alpha + \cot\beta}$

and $\cot(\alpha-\beta) = \frac{\cot\alpha \cdot \cot\beta + 1}{\cot\beta - \cot\alpha}$

The proof of this is also left to the student as an exercise.

We set down here the formulæ we have proved which are of great importance

$\cos(\alpha+\beta) = \cos\alpha \cdot \cos\beta - \sin\alpha \cdot \sin\beta$

$\sin(\alpha+\beta) = \sin\alpha \cdot \cos\beta + \cos\alpha \cdot \sin\beta$

$\cos(\alpha-\beta) = \cos\alpha \cdot \cos\beta + \sin\alpha \cdot \sin\beta$

$\sin(\alpha-\beta) = \sin\alpha \cdot \cos\beta - \cos\alpha \cdot \sin\beta$

Also

$\tan(\alpha+\beta) = \frac{\tan\alpha + \tan\beta}{1 - \tan\alpha \tan\beta}$

$\cot(\alpha+\beta) = \frac{\cot\alpha \cdot \cot\beta - 1}{\cot\alpha + \cot\beta}$

$\tan(\alpha-\beta) = \frac{\tan\alpha - \tan\beta}{1 + \tan\alpha \cdot \tan\beta}$

$\cot(\alpha-\beta) = \frac{\cot\alpha \cdot \cot\beta + 1}{\cot\beta - \cot\alpha}$

20. These formulæ may be used to find the trigonometrical ratios of angles which can be expressed as the sum or difference of angles whose ratios are known

Thus $\sin 15° = \sin(45° - 30°)$

$= \sin 45° \cdot \cos 30° - \cos 45° \cdot \sin 30°$

$= \frac{1}{\sqrt{2}} \cdot \frac{\sqrt{3}}{2} - \frac{1}{\sqrt{2}} \cdot \frac{1}{2} = \frac{\sqrt{2}}{4}(\sqrt{3} - 1)$

Again $\tan 75° = \tan (45° + 30°) = \dfrac{\tan 45° + \tan 30°}{1 - \tan 45° \cdot \tan 30°}$

$= \dfrac{1 + \frac{1}{\sqrt{3}}}{1 - 1 \cdot \frac{1}{\sqrt{3}}} = \dfrac{\sqrt{3} + 1}{\sqrt{3} - 1} = \dfrac{4 + 2\sqrt{3}}{3 - 1} = 2 + \sqrt{3}$

21. Further formulæ may be deduced from the formulæ of § 18.

The product of the sines of the sum and difference of two angles is equal to the difference of the squares of the sines of the component angles.

If the angles be α and β

$\sin (\alpha + \beta) \sin (\alpha - \beta)$

$= (\sin \alpha \cdot \cos \beta + \cos \alpha \cdot \sin \beta)$
$(\sin \alpha \cdot \cos \beta - \cos \alpha \cdot \sin \beta)$

$= \sin^2 \alpha \cos^2 \beta - \cos^2 \alpha \sin^2 \beta$

$= \sin^2 \alpha (1 - \sin^2 \beta) - (1 - \sin^2 \alpha) \sin^2 \beta$

$= \sin^2 \alpha - \sin^2 \beta.$

Hence $\sin (\alpha + \beta) \sin (\alpha - \beta) = \cos^2 \beta - \cos^2 \alpha$ and similarly we may show that

$\cos (\alpha + \beta) \cos (\alpha - \beta) = \cos^2 \alpha - \sin^2 \beta$
$= \cos^2 \beta - \sin^2 \alpha.$

22. Now consider the trigonometrical ratios of the angle 2α.

$\cos 2\alpha = \cos (\alpha + \alpha)$
$= \cos \alpha \cdot \cos \alpha - \sin \alpha \cdot \sin \alpha$
$= \cos^2 \alpha - \sin^2 \alpha$
$= \cos^2 \alpha - (1 - \cos^2 \alpha) = 2 \cos^2 \alpha - 1$
$= 1 - 2 \sin^2 \alpha$

Thus $\cos 2\alpha = \cos^2 \alpha - \sin^2 \alpha = 2 \cos^2 \alpha - 1$
$= 1 - 2 \sin^2 \alpha$

From this we may deduce that

$\cos^2 \alpha = \frac{1}{2} (1 + \cos 2\alpha)$
$\sin^2 \alpha = \frac{1}{2} (1 - \cos 2\alpha)$

The geometrical proof of the above is left as an exercise for the student.

Again $\sin 2\alpha = \sin (\alpha + \alpha)$
$= \sin \alpha \cdot \cos \alpha + \cos \alpha \cdot \sin \alpha$
$= 2 \sin \alpha \cdot \cos \alpha.$

And $\tan 2\alpha = \tan (\alpha + \alpha) = \dfrac{\tan \alpha + \tan \alpha}{1 - \tan \alpha \cdot \tan \alpha}$

$= \dfrac{2 \tan \alpha}{1 - \tan^2 \alpha}$

Hence, $2 \cot 2\alpha = \dfrac{2 (1 - \tan^2 \alpha)}{2 \tan \alpha} = \dfrac{1}{\tan \alpha} - \tan \alpha$

$= \cot \alpha - \tan \alpha$

23. Next consider the trigonometrical ratios of 3α.

$\cos 3\alpha = \cos (2\alpha + \alpha) = \cos 2\alpha \cdot \cos \alpha$
$- \sin^2 \alpha \cdot \sin \alpha$
$= (2 \cos^2 \alpha - 1) \cos \alpha$
$- 2 \sin \alpha \cdot \cos \alpha \sin \alpha$
$= 2 \cos^3 \alpha - \cos \alpha - 2 \sin^2 \alpha \cos \alpha$
$= 2 \cos^3 \alpha - \cos \alpha - 2 \cos \alpha (1 - \cos^2 \alpha)$
$= 4 \cos^3 \alpha - 3 \cos \alpha$

$\sin 3\alpha = \sin (2\alpha + \alpha) = \sin 2\alpha \cdot \cos \alpha$
$+ \cos 2\alpha \cdot \sin \alpha$
$= 2 \sin \alpha \cos \alpha \cos \alpha$
$+ (1 - 2 \sin^2 \alpha) \sin \alpha$
$= 2 \sin \alpha (1 - \sin^2) \alpha + \sin \alpha$
$- 2 \sin^3 \alpha$
$= 3 \sin \alpha - 4 \sin^3 \alpha.$

$\tan 3\alpha = \tan (2\alpha + \alpha) = \dfrac{\tan 2\alpha + \tan \alpha}{1 - \tan 2\alpha \cdot \tan \alpha}$

$= \dfrac{\frac{2 \tan \alpha}{1 - \tan^2 \alpha} + \tan \alpha}{1 - \frac{2 \tan \alpha}{1 - \tan^2 \alpha} \cdot \tan \alpha} = \dfrac{2 \tan \alpha + \tan \alpha - \tan^3 \alpha}{1 - \tan^2 \alpha - 2 \tan^2 \alpha}$

$= \dfrac{3 \tan \alpha - \tan^3 \alpha}{1 - 3 \tan^2 \alpha}$

24. Trigonometrical transformations.

We have

$$\left.\begin{aligned} \sin (\alpha + \beta) &= \sin \alpha \cdot \cos \beta + \cos \alpha \cdot \sin \beta \\ \sin (\alpha - \beta) &= \sin \alpha \cdot \cos \beta - \cos \alpha \cdot \sin \beta \end{aligned}\right\} \ldots (i)$$

$$\left.\begin{aligned} \cos (\alpha + \beta) &= \cos \alpha \cdot \cos \beta - \sin \alpha \cdot \sin \beta \\ \cos (\alpha - \beta) &= \cos \alpha \cdot \cos \beta + \sin \alpha \cdot \sin \beta \end{aligned}\right\} \ldots (ii)$$

By addition and subtraction of equations (i) and also of equations (ii) we get

$$\left.\begin{aligned} \sin (\alpha + \beta) + \sin (\alpha - \beta) &= 2 \sin \alpha \cdot \cos \beta \\ \sin (\alpha + \beta) - \sin (\alpha - \beta) &= 2 \cos \alpha \cdot \sin \beta \\ \cos (\alpha + \beta) + \cos (\alpha - \beta) &= 2 \cos \alpha \cdot \cos \beta \\ \cos (\alpha - \beta) - \cos (\alpha + \beta) &= 2 \sin \alpha \cdot \sin \beta \end{aligned}\right\} \ldots (iii)$$

We may put equations (iii) in a more convenient form by putting $\alpha + \beta = \delta$ and $\alpha - \beta = \theta$

So that $\alpha = \dfrac{\delta + \theta}{2}$ and $\beta = \dfrac{\delta - \theta}{2}$

Then we get

$$\left.\begin{aligned} \sin \delta + \sin \theta &= 2 \sin \frac{\delta + \theta}{2} \cdot \cos \frac{\delta - \theta}{2} \\ \sin \delta - \sin \theta &= 2 \cos \frac{\delta + \theta}{2} \cdot \sin \frac{\delta - \theta}{2} \\ \cos \delta + \cos \theta &= 2 \cos \frac{\delta + \theta}{2} \cdot \cos \frac{\delta - \theta}{2} \\ \cos \theta - \cos \delta &= 2 \sin \frac{\delta - \theta}{2} \cdot \sin \frac{\delta - \theta}{2} \end{aligned}\right\} \ldots (iv)$$

The equations (iv) may be more readily remembered if put into words thus:

The sum of the sines of two angles is equal to twice the sine of half their sum multiplied by the cosine of half their difference.

The sine of the greater of two angles minus the sine of the less is equal to twice the cosine of half their sum multiplied by the sine of half their difference.

The sum of the cosines of two angles is equal to twice the cosine of half their sum multiplied by the cosine of half their difference.

The cosine of the lesser of two angles minus the cosine of the greater is equal to twice the sine of half their sum multiplied by the sine of half their difference.

Exercise 3

Find the following.

(1) Tan 15°. (2) cos 75°. (3) cos 15°.

(4) Prove geometrically that $\cos 2a = \cos^2 a - \sin^2 a$.

(5) If $\tan \alpha = \frac{1}{2}$ and $\tan \beta = \frac{1}{3}$ prove that $\tan (\alpha + \beta) = \frac{5}{7}$ and $\tan (\alpha - \beta) = \frac{1}{7}$.

(6) If $\tan \alpha = n$ and $\tan B = \frac{1}{n}$, prove that $\tan (\alpha + \beta) = \infty$. What is the value of $\alpha + \beta$?

Key to Exercise 1

(7) $\frac{3}{4}$, $\frac{5}{3}$, $\frac{4}{5}$. (8) $\dfrac{a}{\sqrt{a^2 + b^2}}$, $\dfrac{b}{\sqrt{a^2 + b^2}}$.

(10) $\dfrac{1 - n^2}{1 + n^2}$, $\dfrac{1 - n^2}{2n}$. (13) $3\frac{1}{16} - \dfrac{\sqrt{3}}{2}$.

(14) 180°. (15) 375°.

M. A. L.

MECHANICS.—IV

25. Composition of Constant or Uniform Accelerations.—Since acceleration is the velocity gained per second, accelerations may evidently be compounded by the same laws as velocities. Thus if a body be subject to an acceleration whose magnitude and direction is represented by the line O A and also to another acceleration whose magnitude and direction is represented by O B, then O A and O B represent the velocities gained in one second in these two directions, and therefore the actual velocity gained in the time is O C, the diagonal of the parallelogram, i.e. O C represents in magnitude and direction the actual gain in velocity or, in other words, O C represents the resultant acceleration.

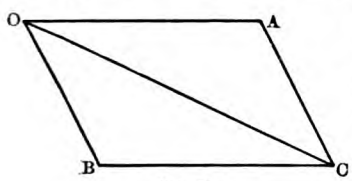


Fig. 13.

Thus the parallelogram law holds good for accelerations.

From the above and from the triangle and polygon of velocities the following may easily be deduced.

(1) *If a body be subjected to three accelerations which can be represented in magnitude and direction by the sides of a triangle taken in order, then the body will either remain at rest or will continue to move with uniform velocity in a straight line.*

This is the **Triangle of Accelerations**

(2) *Similarly: If a body have any number of component accelerations represented by the sides of a closed polygon taken in order, then the body will either remain at rest or continue to move in a straight line with a uniform velocity.*

This is the **Polygon of Accelerations.**

In each case the resultant acceleration is zero, and ∴ there is no change in the velocity of the body.

The resolution of accelerations may be carried out in the same way as the resolution of velocities.

26. Relative Motions.

Hitherto we have dealt with a single body subjected to two or more velocities or accelerations, except when we dealt with relative velocities in parallel directions. We now turn to the case of two bodies moving simultaneously. In order to find the relative velocity of one with regard to the other, we have recourse to the following device: we imagine a fictitious velocity to be imposed on both bodies A and B, and this fictitious velocity we choose equal in magnitude and *opposite* in direction to that of one of the bodies, say A. The resultant velocity of A will be zero, i.e. A will be brought to rest; the resultant velocity of B will be compounded of B's own velocity and the fictitious velocity imposed on B, and will clearly give us B's velocity relative to A (since A has been brought to rest).

This device may strike the student as somewhat arbitrary, but a little thought will show him that it is one he constantly, though probably unconsciously, applies. If we speak of a train travelling at 40 miles per hour we mean that its velocity *relative to the earth* is 40 miles per hour, and we imply thereby that we regard the earth as if it were at rest—i.e. in our minds we impose on the earth a velocity equal and opposite to its actual velocity.

Consider two ships A and B, when A is sailing due east with a uniform velocity v and B is sailing due south with a uniform velocity u.

Suppose their position is given by the fact that A is at a distance a and B is at a distance b from the point O where their paths cross.

The ships will collide if they both reach O at the same moment, i.e. if $\frac{a}{v} = \frac{b}{u}$, i.e. $v : u :: a : b$. In other words, if their velocities are in the same proportion as their distances from the point at which their paths cross, the ships will collide unless at least one of them alters her course. But if their velocities are not in this proportion they will pass one another, and we will find the minimum distance between them.

Suppose a fictitious velocity $-u$ to be impressed on the whole system, i.e. on both A and B. Then B is brought to rest and A will move in the direction A P at a velocity of $\sqrt{u^2 + v^2}$ (represented by A C). The minimum distance between A and B will be given by a perpendicular B N from B on to A P. This will give the actual distance, but will not show the positions which A and B will occupy when at a minimum distance. Since B sails due south and A sails due east,

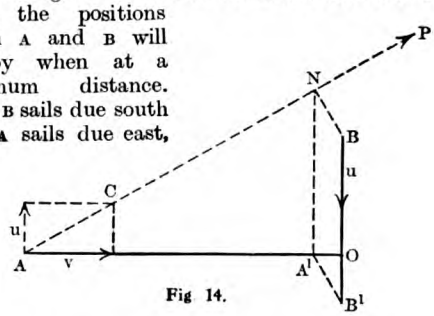


Fig 14.

the actual positions are given by B^1 and A^1, where $B^1 A^1$ is drawn parallel and equal to B N. If the figure is drawn to scale, the problem is solved by this geometrical construction.

Supposing the distance $A A^1 = d$ and the distance $B B^1 = d^1$; let t be the number of seconds which it takes A and B to reach A^1 and B^1. Then $d = vt$ (1) and $d^1 = ut$ (2)

$\therefore A^1 O = a - d = a - vt$ and $O B^1 = d^1 - b = ut - b$

Also $\triangle A^1 O B^1$ is similar to $\triangle N A^1 A$

$$\therefore \frac{A^1 O}{O B^1} = \frac{N A^1}{A^1 A}, \text{ i.e. } \frac{a - d}{d^1 - b} = \frac{d^1}{d} \quad (3)$$

From the above three equations we can find the place, time and distance corresponding to the positions A^1 and B^1.

The time t we find as follows:

from (3) $\frac{a - d}{d^1 - b} = \frac{d^1}{d} = \frac{u}{v}$ from (1) and (2)

putting in for d and d^1 from (1) and (2)

$$\frac{a - vt}{ut - b} = \frac{u}{v} \quad \therefore t(v^2 + u^2) = av + bu$$

$$\therefore t = \frac{av + bu}{v^2 + u^2}$$

Also $a - d = a - vt = \dfrac{u(au - bv)}{v^2 + u^2}$

and $d^1 - b = \dfrac{v(au - bv)}{v^2 + u^2}$

and finally the minimum distance $A^1 B^1$

$= \sqrt{(a-d)^2 + (d^1 - b)^2}$

$= \sqrt{\dfrac{(au - bv)^2}{(v^2 + u^2)}\ (v^2 + u^2)}$

$= \sqrt{v^2 + u^2}\ \dfrac{(au - bv)}{v^2 + u^2} = \dfrac{au - bv}{\sqrt{v^2 + u^2}}$

Example:—A man sets out to cross a railway line 40 yards wide at the rate of 5 miles an hour. A train travelling at the rate of 40 miles an hour is coming along a track in the centre. He walks straight across and when he starts the train is still 165 yards away from the point where he will cross the central track. By how much does he miss being run over, and what is the shortest distance between him and the train ?

The man has to walk 20 yards to reach the central track.

This will take him $\dfrac{20 \times 60}{5 \times 1760}$ min. $= \dfrac{3}{22}$ min.

In $\dfrac{3}{22}$ min. the train travels $\dfrac{3}{22} \times \dfrac{40 \times 1{,}760}{60}$ yds. $= 160$ yds.

$\therefore$ the man misses the train by $(165 - 160)$ yds. $= 5$ yds. The least distance between them we can find by the formula above, i.e. $\dfrac{au - bv}{\sqrt{v^2 + u^2}}$

$= \dfrac{165 \times 5 - 40 \times 20}{\sqrt{40^2 + 5^2}}$

$= \dfrac{25}{\sqrt{1{,}625}} = \dfrac{5}{\sqrt{65}} = \dfrac{\sqrt{65}}{13} = \dfrac{8{\cdot}062}{13} = {\cdot}62$ yds.

Exercise 4

(1) A steamboat A steams N with a constant velocity of 12 miles an hour, another B, steams E with a constant velocity of 16 miles an hour. When A is due east of B it is 10 miles from it. Find the velocity of B relative to A, and the nearest distance to which the boats will approach.

(2) A steamer is going due north. The wind is blowing from the north-east. Relative to the surface of the sea, the wind and the steamer have equal velocities of 10 $\dfrac{\text{m.}}{\text{hr.}}$. Draw a figure showing the direction of the trail of smoke, and from your figure estimate the length of trail emitted in 1 hour.

(3) A bird can fly in still air at 20 miles an hour. When a wind is blowing straight from the north at 10 miles an hour, in what direction must the bird aim in order that it may fly from east to west, and at what speed will it travel relative to the earth's surface ?

(4) A meteorite burst at a height of 57,600 feet, and one of the fragments was brought instantaneously to rest by the explosion. It then descended with an acceleration of 32 $\dfrac{\text{ft.}}{\text{sec.}^2}$, while the sound of the explosion travelled with a velocity of 1,100 $\dfrac{\text{ft.}}{\text{sec.}}$. Which reached the ground first, the fragment or the sound, and what time did each take ?

(5) If a point has a velocity of 1 ft. per sec. to the east, and also a velocity of $\sqrt{3}$ ft. per sec. to the north, determine the velocity which must be compounded with these to bring the point to rest.

The above questions are taken from the London Matric. Exam.

27. Motion in a Curve.

Velocity and acceleration besides changing in magnitude may change in *direction*. When the direction of motion is constantly changed, the path described is a **curve.**

The rate of change of direction per unit length of the curve is called its **curvature.** This in most curves (such as a parabola or ellipse) is itself variable, but the curvature of a circle is constant. A straight line has zero curvature. Curvature is measured by the angle through which the direction of motion has turned (in circular measure) divided by the distance actually travelled. If a point travels right round a circle its direction of motion turns through 4 right angles $= 2\pi$ in circular measure. The distance travelled is the circumference $= 2\pi \times r$ where $r =$ radius of the circle. Hence the curvature of a circle $= \dfrac{2\pi}{2\pi r} = \dfrac{1}{r}$. The curvature of any small section of any other curve is taken to be equal to the curvature of that circle which most nearly coincides with the curve at the small section considered, i.e. the curvature of that section is taken as the reciprocal of the radius of the circle which most nearly coincides with it.

The circular measure of an angle at the centre of a circle is obtained by dividing the arc subtended by this angle by the radius. This ratio $\dfrac{\text{arc}}{\text{radius}}$ depends only on the size of the angle and is independent of the size of the circle. The unit of this measure is the angle for which the above ratio is $= 1$, i.e. an angle which subtends a length of arc equal to the radius. It is called a **radian,** and equals about 57° 17′ 45″. The circular measure of any other angle is equal to the number of radians it contains. The circular of 4 right angles $= \dfrac{\text{circumference}}{\text{radius}} = \dfrac{2\pi r}{r} = 2\pi$ where π is the ratio of the circumference to the diameter and $= 3{\cdot}14159$ approximately.

A point moving along a curve, besides any acceleration it may possess *along* the curve, has an acceleration at right angles to its direction of motion at any point, or, as it is called, **normal** to its direction of motion. This acceleration does not increase or decrease the magnitude of the velocity, but only affects its direction. We shall discuss this in detail later, when we shall find that normal acceleration $= \dfrac{v^2}{r}$ where v is the velocity along the curve and $\dfrac{1}{r}$ measures the curvature.

28. Rotation.

What we have hitherto said of the motion of a point in a straight line applies equally to the motion of an extended body in so far as the motion of translation is concerned, but an extended body may also have a motion of rotation ; these forms of motion may occur separately or in combination.

When a body rotates, every point in it describes

a circle round the axis of rotation. The speed with which the body rotates is usually given in terms of the number of revolutions it makes in one second. Consider a rod A B on a pivot at A. Suppose it rotates round A in a horizontal plane. In one complete revolution B will travel round the circumference of a circle of radius A B, i.e. it will cover a distance $= 2\pi$ A B. In the same time C will cover a distance $= 2\pi$ A C, and since A C is less than A B, the velocity of C will be less than the velocity of B, i.e. the velocity of any individual point is proportional to its distance from the axis of rotation.

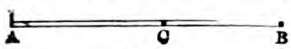


Fig. 15.

The rate at which the rod turns, in other words, the number of radians it turns through per second, is called its **angular velocity.**

The actual velocity v of any point on the body is clearly the product of its angular velocity ω and its distance from the axis of rotation, i.e. $v = r\omega$ (where r = radius of circle described by the point).

If angular velocity be variable, its rate of change per second is called **angular acceleration.**

If α = angular acceleration $\alpha = \frac{\omega}{t} = \frac{v}{rt} = \frac{vt}{r} = \frac{a}{r}$

Examples :—

(1) A wheel makes 40 revolutions per minute. What is angular velocity in radians per second?

40 revolutions per minute $= \frac{2\pi}{60} \times 40$ radians per second $= \frac{4}{3} \times 3{\cdot}14159 \frac{\text{radians}}{\text{sec.}} = 4{\cdot}189 \frac{\text{radians}}{\text{sec.}}$.

(2) A wheel of radius 7 inches is turning uniformly once a second about a horizontal axis fixed in the centre of the wheel and projecting equally from its two sides. The axle itself performs a complete revolution about its centre in a horizontal plane once a second. Find the magnitude in feet per second of the velocity of a mark on the rim of the wheel when the line joining it to the centre of the wheel is (1) vertical, (2) horizontal. (London Matric. Exam.)

The crosses indicate the position of the mark in the two cases.

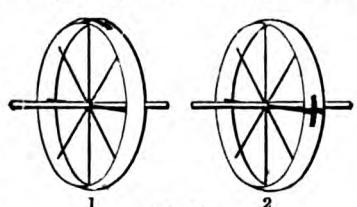


Fig. 16.

Supposing the axle were fixed the mark would describe a circle of circumference $2\pi \times 7$ inches per sec. $\therefore$ the velocity would be $\frac{2\pi \times 7}{12} \frac{\text{ft.}}{\text{sec.}}$

$= 3{\cdot}665 \frac{\text{ft.}}{\text{sec.}}$

If the wheel did not rotate round the axle, but were fixed to it, the rotation of the axle round its centre in a horizontal plane would not cause the top and bottom points of the wheel to move at all; they would remain at rest, and $\therefore$ in case (1) the velocity of the mark is only the velocity due to the rotation of the wheel round the axle, i.e. $3{\cdot}665 \frac{\text{ft.}}{\text{sec.}}$.

But if the wheel is fixed to the axle, the rotation of the latter round its centre in a horizontal plane would cause the mark in case (2) to describe a circle of radius 7 inches per second in a horizontal plane, i.e. it would have a velocity of $3{\cdot}665 \frac{\text{ft.}}{\text{sec.}}$

Hence the velocity of the mark at the moment when the line joining it to the centre of the wheel is horizontal is the resultant of a vertical velocity of $3{\cdot}665 \frac{\text{ft.}}{\text{sec.}}$ and of a horizontal velocity of $3{\cdot}665 \frac{\text{ft.}}{\text{sec.}}$.

$\therefore$ the actual velocity

$= \sqrt{(3{\cdot}665)^2 + (3{\cdot}665)^2} \frac{\text{ft.}}{\text{sec.}}$

$= 5{\cdot}18 \frac{\text{ft.}}{\text{sec.}}$ approximately.

Exercise 5

(1) A wheel of radius 50 centimetres revolves 50 times in $2\frac{1}{2}$ seconds; find the actual distance travelled in two seconds by a point on the rim of the wheel.

(2) A cart with wheels 5 ft. high is moving at the rate of 16 miles an hour. Find the angular velocity of the wheels and also the speed with which a mark on the rim of the wheel passes the step up to the driver's seat.

(3) The wheels of a bicycle are 30 inches in diameter, each crank is $7\frac{1}{2}$ inches long and is geared so as to make one revolution while the wheels make two. Find the actual velocity of the end of the crank (i) when at the highest, and (ii) at the lowest point of its path when the bicycle is travelling with a velocity of 10 miles an hour.

Work out the same problem supposing that two revolutions of the crank corresponded to one of the wheels.

Find the velocity of the end of the crank relative to the bicycle.

[Remember that, if this velocity $= v$, the actual velocity of the end of the crank will be $(10 + v)$ in the highest and $(10 - v)$ in the lowest position, since in the former the crank has a horizontal velocity forwards and in the latter a horizontal velocity backwards.]

(4) The hour and minute hands of a watch which loses 12 minutes per day are 14 and 20 cms. long respectively. With what velocities do the points of the hands describe their circular paths, and what is their relative velocity at noon by the watch?

(5) On a vertical spindle which rotates uniformly 4 times per second are fixed 3 horizontal discs each with a hole in it. The holes lie in a vertical straight line. A bullet is dropped from a point one foot above the highest disc and falls through the holes in succession. Find the minimum distance between the discs. $\left(\text{Take } g = 32 \frac{\text{ft.}}{\text{sec.}^2}\right)$

Questions 3, 4, 5 are from the London Matric. Exam.

Key to Exercise 3

(1) (*a*) $5 \frac{\text{ft.}}{\text{sec.}}$ (*b*) $\sqrt{29} \frac{\text{ft.}}{\text{sec.}}$ (*c*) $\frac{4}{3}\sqrt{709} \frac{\text{ft.}}{\text{sec.}}$. (2) $\frac{15}{2}\sqrt{2} \frac{\text{ft.}}{\text{sec.}}$ along each. (3) $\frac{3}{2} \frac{\text{ft.}}{\text{sec.}}$ and $\frac{3\sqrt{3}}{2} \frac{\text{ft.}}{\text{sec.}}$; $2 \frac{\text{ft.}}{\text{sec.}}$ and $2\sqrt{3} \frac{\text{ft.}}{\text{sec.}}$; $\frac{5}{2} \frac{\text{ft.}}{\text{sec.}}$ and $\frac{5\sqrt{3}}{2} \frac{\text{ft.}}{\text{sec.}}$; $3 \frac{\text{ft.}}{\text{sec.}}$ and $3\sqrt{3} \frac{\text{ft.}}{\text{sec.}}$. (5) $4\sqrt{109} \frac{\text{ft.}}{\text{sec.}}$. M. A. L.

Continued from page 178.

ART AND MUSIC:

Contributors **:—THE THEORY OF ART (Hon. John Collier; J. G. B. Lynch). DRAWING AND PAINTING (J. G. B. Lynch). THE THEORY OF MUSIC (R. R. Terry, Mus.Doc., F.R.C.O.; Hubert Grant).**

DRAWING.—XVII

HAVING sketched out the rules to be observed in dealing with outline, it is now necessary to treat on the method of shading. In carrying out the instructions already given you in previous lessons you will no doubt have acquired considerable freedom and confidence in drawing an outline by means of hard lines, which mark the extreme boundaries of the figure. But we have been unable by this means to express adequately many formations that exist.

The surface of both the face and the figure change considerably with every movement; different muscles are brought into prominence with the slightest variation of pose, and you will readily perceive that it is impossible to represent these delicate changes by means of hard lines. Therefore, we have to bring to our aid a new method, and we can only show the varieties of these slight changes in the surface by means of shading.

A very marked change is noticeable in this respect when the figure changes from movement to a state of repose. When you come to draw a figure in vigorous action you will see that the muscles stand out much more boldly than is the case when in repose; and consequently the whole contour of the surface is entirely altered.

Fig. 87

One of the best means of becoming proficient in this phase of your art is to take some object and whitewash it. When it is dry this object will make an excellent model from which to practise the art of shading, for it will exhibit very clearly the degree of light and shade, from the highest light to the darker shadows, and it will also throw a shadow upon the surface on which it is standing. Some round object such as a football will serve your purpose admirably.

One little hint with regard to drawing the outline will be useful before you proceed with further details as to the treatment of light and shade. In your earlier attempts you will often find that you are compelled to make many alterations as you draw the outline, that the continual use of the india-rubber destroys the surface of the paper, and that your lines become woolly; so that however skilfully you execute your shading, you can never hope to complete a clean, sharp drawing.

Under these circumstances it is a good plan to use the following method to overcome this dirty appearance. If you find that the surface of the paper has been destroyed, the best thing to do is to make a tracing of the outline. Take an ordinary sheet of paper, and blacken the entire surface by means of a BB pencil. Now fasten a new sheet of paper on your drawing-board; place your tracing paper face downwards upon it; above this lay your outline, face upwards; then pin them together and with a hard sharp-pointed pencil follow the outline of your drawing, pressing firmly as you do so.

This will print upon the clean paper a clear and accurate copy of your work. You can now proceed with your shading. Begin by drawing the object by means of a very faint outline; then mark with a still fainter outline, if possible, the boundaries of the shadows. If this outline is too distinct it will immediately catch the eye and kill all soft gradations, which are essential to a satisfactory result.

Although you must, in practising, use a distinct line to determine the boundary of each gradation of shade, it should be done in such a delicate manner that when the shading is complete these initial lines become absorbed and consequently entirely disappear. These boundary lines should be used not only to mark the tones and half-tones on the object itself, but also to mark in the same way the extent of the shadow that the object casts on the surface upon which it is standing.

Before you attempt this extremely delicate work it is a good plan to look at the model for a short time with the eyes half closed. By this means you will be able to decide more accurately the extremities of the full shadow and the half-tones. Having made these observations, begin by filling in the whole of the heavy shadows with a flat, even shading of about the same strength in tone as the reflections. A glance at Figure 87 will show you clearly what is meant.

Now indicate the shadows of the greatest depth by crossing lines, being careful to lift the pencil from the paper.

Next deal with the semi-tones, which connect the high lights with the heavy shadows and indicate also the minor tones caused by the varied surface of the model; these you will see are clearly shown in Figure 90. In laying on the flat, even tint, which forms the ground-work of your heavy and cast shadows, a stump may be used with advantage, but in this initial process only should it be employed by the beginner. The second process, namely the working in of the heavy shadows and the semi-tones connecting the high lights, must be drawn with the pencil by means of fine lines.

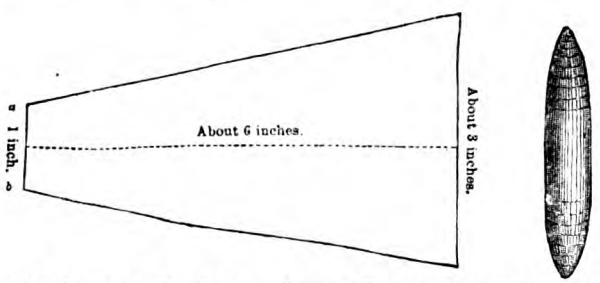


Fig. 88.—Showing how a "stump" may be quickly and easily manufactured from grey packing paper.

This mode of procedure should be adhered to, at any rate until you have acquired considerable skill in handling the stump. Later on, no doubt you will be able to use this instrument for the dark and half-tones, but in this respect you must use your own judgment, for if you attempt to do this before you are competent your work will appear dirty, and consequently suffer in proportion.

In case you do not possess a stump, or find any difficulty in procuring one, you can very quickly manufacture one for yourself. The most satisfactory result is to be obtained by making it of grey packing-paper, though other coarse papers will also serve the purpose. Figure 88 will give you an idea as to the size, and also as to the method of its manufacture. Begin by rolling the paper closely at the broader end, finishing with *a b*.

If you make it carefully, it will be very tight and firm, with hard points at each end. You can easily secure the end of the paper with a little paste or gum, applied at *a b*, binding it for a few moments to hold it in position. As soon as it is dry it will be ready for use. Now get a piece of strong paper with a good smooth surface and blacken it with a broad-pointed BB pencil; next rub the end of the stump on the leaded surface; and when it is well covered you may then use it to soften the shadow, as evenly as you possibly can.

The most difficult part of the drawing lies in uniting satisfactorily by means of semi-tones the high lights with the deep shadows. Unless this is accomplished skilfully, your work will have a smudgy appearance, and it is only by considerable practice that you will obtain that delicate touch required in the treatment of light and shade.

The instructions given in the preparatory stages hold good throughout the whole of the course. Your object must be to acquire a bold free line which shows no hesitation in its execution. Patience

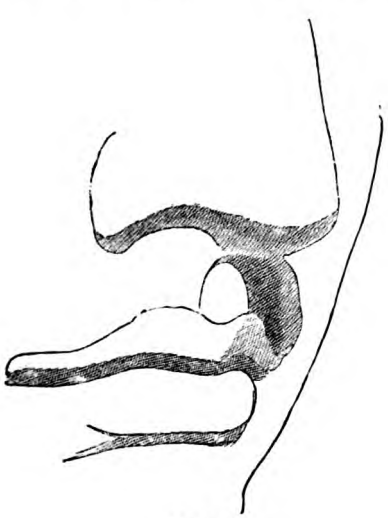


Fig. 89.

Fig. 90.

and perseverance are the only means by which this gift can be cultivated. Do not confuse boldness of type with rapidity. Bold drawing, or as it is very aptly described free-hand drawing, is accomplished without apparent effort, with a quiet, confident manner which is the result of thorough knowledge and keen and constant observation, really more mental than mechanical. The artist, for example, who draws animals successfully has not only a thorough knowledge of their outward appearance, but also of their habits.

This knowledge unconsciously makes itself apparent in his work, but is at once recognised and felt by all who see the work. The latent knowledge that the mind possesses has enormous influence in guiding the hand, because if the mind is equipped in this manner it is able at once to picture the result desired, and will consequently guide the hand accurately, directly towards the accomplishment of its purpose. This is the explanation of what we mean when we say that a picture lacks soul or inspiration; although the draughtsman may have reproduced a faithful copy of the outward form, his work, without thorough knowledge of his subject, lacks life, and consequently is not really a work of art.

Reward of Industry

In these lessons you have been given instructions that are necessary for successful and faithful imitations. For the rest we can only tell you in a general way how to direct your efforts in order to achieve a higher standard; you must make a thorough study of the subject you desire to portray in a far more intimate manner than is to be obtained by mere ocular observation.

Sir Joshua Reynolds in one of his lectures to the students at the Royal Academy laid great emphasis on this point:—

"There is one precept in which I shall be opposed only by the vain, the ignorant and the idle. I am not afraid that I shall repeat it too often. You must have no dependence on your own genius. If you have talents, industry will improve them; if you have moderate abilities, industry will supply their deficiency. Nothing is denied to well-directed labour; nothing is to be obtained without it. Not to enter into metaphysical discussions on the nature or essence of genius, I will venture to assert that assiduity, unabated by difficulties, and a disposition eagerly directed to the object of its pursuit will produce effects similar to those which some call the result of natural powers. Though a man cannot at all times and in all places paint or draw, yet the mind can prepare itself—by laying in proper materials, at all times and in all places."

Nothing surely could be more encouraging to the student than these remarks, coming as they do from one of our most successful and eminent painters, who had himself climbed the ladder of fame and had employed the very methods he urges in achieving his success. His dictum that industry will not only improve talent, but will supply the deficiency to those who have only moderate talents, is indeed a solace to those who feel that they have not great genius, but are only possessed of ordinary talents. J. G. B. L.

WALLPAPERS

THE problem which constantly worries the fastidious householder is the covering of his walls. He has to consider the questions of lightness and darkness, the size and shape of his rooms, the suitability of papers in regard to his furniture and the matter of colour schemes. In previous essays at the conclusion of technical lessons I have spoken of simplicity and elaboration as applied to household decoration. Elaboration of the costly sort may be neglected in the present essay. For with the question of expense eliminated there is little difficulty. Panelling is the most attractive wall covering of all, and that, of course, is expensive. Much more so is stamped leather, or thick brocade, both of which may be extremely beautiful, but for the ordinary individual are ruled out.

Wallpapers, or the admirable substitute —distemper—form most people's great problem. Various things have to be borne in mind. Some colours fade, some grow darker in the sun. This latter happens sometimes in the case of a plain greyish-white paper, which, where it is exposed to the rays of the sun, becomes a brownish yellow.

Simple Colours

If you are an apostle of simplicity, you will choose plain papers. If this is the case, your task is simplified enormously. As in everything else, the best that money can buy is always the cheapest, and good thick papers well repay you. Brown paper is delightful in a well-lit room with plenty of white paint about. Certain shades of blue are cool and attractive. With the reds and yellows you have to be extremely careful. And after all if you line your house with perfectly plain white paper throughout you cannot go very far wrong. It forms a good background for any sort of furniture, any kind of picture or frame or curtain. Nothing can be out of harmony with white.

But then to some people colour is as urgently imperative to existence as bread or blankets. And they feel that they must have colour upon their walls. Good colour in wallpapers, then, is fairly easy to procure and choose. The really difficult question is one of design. Now there are enormous numbers of designs in wallpaper, from huge garlands of roses which hang from heavy stripes that are meant to be columns, to the modest little *fleur-de-lis* which stands inconspicuously here and there upon a small check. There are Morris papers whose vogue waned to rise again, there are copies of the early Georgian papers with brilliant colours and very large

THE DAISY AND—

designs—these latter can only be used with propriety in large rooms. It is so purely a personal matter that no one can teach another what to look for save to be sure that the actual drawing of the design is good as well as the colours.

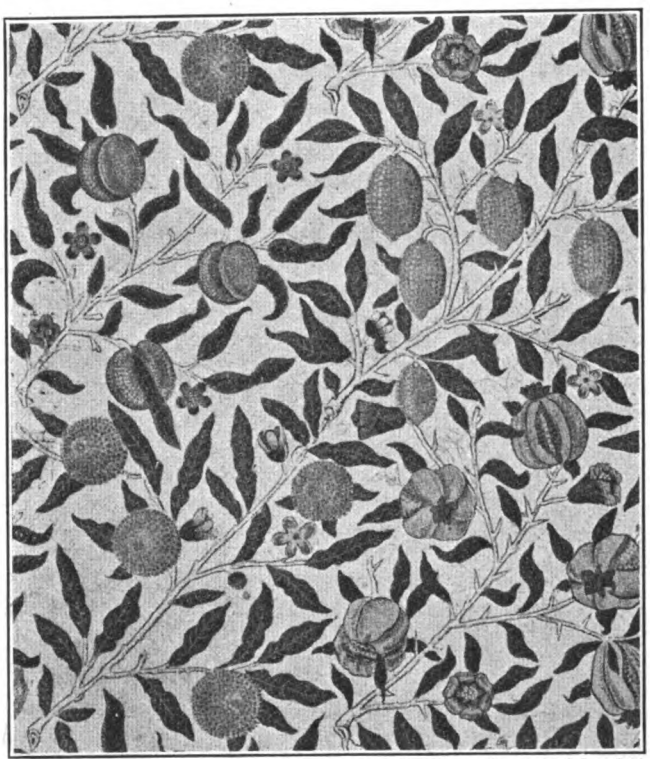
I have in mind one particularly fine paper. This is a close pattern of small dark olive-green leaves, conventionalised but not (as is so often the case with conventions) wooden. I mention this because very close designs are as a rule more generally useful than very open ones. Open designs with large spaces between the objects depicted are hardly ever suitable for small rooms.

And yet when all is said and done, however inconvenient it may be and however prone to come off upon one's clothes, there is nothing like a simple coat of whitewash. One of the most beautiful rooms I ever remember seeing was a long rather low sitting-room, with a timbered ceiling. The heavy cross-beams at intervals of four or five feet met uprights against the walls, and the spaces in between were merely whitewashed. There was an open fireplace of a yellowish stone. Colour was amply supplied by the curtains of a rather bright red and by the rugs. But whitewash is exceedingly inconvenient, for the reason given above.

In certain conditions it would be better to use distemper. It is not such a simple process as white-washing; but if it has been well applied it will prove more serviceable than whitewash.

Whilst art should in many ways conform with domestic utility, it should not be subdued by it entirely. Poor must be your enthusiasm if you will not willingly submit to some little trouble for an agreeable effect.

J. G. B. L.



By permission of William Morris and Co., Ltd.

—THE FRUIT: two characteristic examples of the wall papers designed by William Morris.

Continued from page 184.

BUSINESS AND COMMERCE:

***Contributors*:—BOOK-KEEPING (Frederick Heelis, F.C.I.S.). SHORTHAND (by arrangement with Pitman's Schools). COMMERCIAL TRAINING (Arthur Brooke). CHOOSING A CAREER (A. C. Marshall).**

COMMERCIAL TRAINING.—XXV

SUCCESSFUL shop-keeping is largely dependent upon sound finance.

Old-fashioned tradesmen were in the habit of calculating their profits by the balance in the bank at the close of a given period; but such a looseness of system could not be tolerated in business at the present time. Nowadays, it is essential that the accounts of a shop shall be capable of easy analysis, so that the business may be subdivided into departments, and each department made to show its own profits or losses.

Retailers' Books

To begin at the very bedrock of business accounts, we must take the bank pass book as the basis of the system. It will be far better if this pass book and the banking account it represents can be kept entirely separate from the business itself.

Then, if the proprietor of the business wishes to own a private banking account for his purely personal affairs, it will be a simple matter to open such an account at the same bank and branch; calling the one the "Business Account" and the other the "Private Account."

By following this plan, the accounts of a retail business become doubly easy to keep. The bank pass book shows the amounts paid in from day to day or from week to week; and, as all bills will be settled by cheque, these will be shown on the opposite side of the account. Then, at the end of each half year, when the bank books are made up, the current balance will be plainly set out.

The actual accounts of a retail business must naturally commence with a careful stocktaking. When a new business is being founded the various items as they come from the wholesalers will be entered in the stock book at the net price paid for them. When an old business has been bought, stock will be taken so carefully that the clean, good stock is noted and valued first; broken, damaged items being recorded separately, of course at the lowest possible value consistent with their condition.

It is of the utmost importance that every item of stock shall be entered in this stock book before the shutters are taken down on the day of opening; and that a definite *wholesale* value shall be set upon it in the book. Then, from day to day, as stock is delivered from the merchants or wholesalers, it is entered up and this routine continues until the end of a given period; usually June 30th and December 31st, when the book is closed, and stock taken afresh.

Stock Books

Detailed particulars of this stock should be taken from the rough memoranda to the stock book; and the total value of the whole ascertained. This statement of existing stock should then be neatly ruled off, and beneath it be placed a note on the following lines:

19..		£	*s.*	*d.*
Jan. 1.	Total value of Stock on Dec. 31st, as per above List and Valuation ..	324	17	2

The Stock Account would then proceed normally:

2	1 Gross, 3-lb. packets, Wax Candles ..	4	16	0
3	3 Cases, Packet Tea, 8 oz. etc. etc.			

It stands to reason, of course, that the amount of stock needed for the profitable handling of a business must to a great extent depend upon the nature of that business. It will be readily understood, for example, that the stock of a fishmonger will be practically non-existent, owing to the fact that he must of necessity trade from day to day.

On the other hand, an ironmonger is called upon to carry and to retain probably a larger stock than any other retailer; and it may be said that, by way of compensation as it were, the businesses that carry the largest stocks depend to a considerable extent upon larger profits on the individual article, to allow for some interest upon their locked-up capital.

In some businesses, it is most inadvisable to retain an unduly large stock, on account of deterioration, changes in fashion and so on. In other businesses a large stock may stand for marked prosperity and affluence. The whole secret of the matter, as applied to any trade, is to obtain the largest turnover of money possible in a given time. A stock *must* be carried to meet all contingent calls for goods; and yet the retailer must not be handicapped in the buying for cash of new goods because too great a proportion of his capital is locked up in stock.

And it follows naturally that in all trades there must be a kind of weekly stocktaking for the purpose of placing orders, and quite independently of the stocktaking for the purpose of a periodical financial balance sheet.

Methodical Ordering

The retailer or his representatives must know that there is an efficient store of all the articles in demand; and the only way to ensure this is to fill the shelves, stockroom and warehouse methodically.

So far as the ordering of goods is concerned, the retailer should keep this vitally important work in his own hands. There is a great art in buying—an even greater art than in selling—and the buyer should keep the stock book closely by him at the time he is making up his orders.

Thus, receiving a report from an assistant that the supply of ground rice, for example, is running short, the principal would turn up his stock book to ascertain the precise date on which the last consignment of this commodity was ordered, the price paid, how long it took in the selling, and so on.

Perhaps the latest consignment has been sold in a much shorter time: and, if so, this fact should be taken to signify that the demand for ground rice is increasing, and that the present would be an advantageous moment to order a far larger quantity than usual in order to benefit from the better terms that can be gained from the placing of bigger orders. A. B.

CHOOSING A CAREER.—XXVIII

Lady Dentists, like lady doctors, are increasing numerically, and there are now a great many in practice in different parts of the country.

The training and education follows practically the same lines as that prescribed for male students; and women may train and qualify at the National Dental Hospital and the Royal Free Hospital in the Metropolis, and also at Edinburgh, Dublin, Glasgow and Manchester. The course usually occupies about four years; and the student should be possessed of at least £350 to see her safely through the period of training.

With people taking more and more care of their teeth; and with artificial teeth becoming more and more commonly worn and better constructed and finished, there is likely to be an increasing demand for the services of qualified dental surgeons, among them of course trained women. And, though at present there are many people practising as "dentists," steps are likely to be forthcoming that will make it possible only for qualified dental surgeons to have the professional care of teeth.

But, apart from becoming qualified lady dentists, there are many women employed in dental surgeries. Some of them are in attendance in the surgeries as dental nurses; others act as amanuenses to dental surgeons; and many other women are employed in the mechanical side of dentistry.

Chemists are of two main classes, pharmaceutical and analytical. The former have to do with dispensing, and the supply of drugs and medicines to the general public; the latter are concerned with chemistry work in manufactures, and in the industries of coal, minerals and metals.

To become a pharmaceutical chemist, it is important that the candidate shall be well educated, for he will be called upon either to pass a preliminary examination, or to produce the certificate showing that he has passed the Oxford or Cambridge local.

The candidate then becomes registered by the *Pharmaceutical Society of Great Britain*, whose address is 17 *Bloomsbury Square, London, W.C.*1; and, after registration, is apprenticed to a druggist or chemist for a period of about four years. The fees charged for this apprenticeship vary according to the district, and class of establishment; and whether the apprentice is boarded or lodged or otherwise.

There are two examinations, the Minor and the Major; and fees are payable for

each, ten guineas for the first and three guineas for the second ; and full particulars of the examinations are to be obtained from the Society's Registrar at the address given above.

The early tuition of an analytical chemist is largely dependent upon the school he attends ; and a technical college with plenty of laboratory accommodation should if possible be chosen. Practising analytical chemists receive their diplomas from the *Institute of Chemistry*, of 30 *Bloomsbury Square, London, W.C.*1 ; and here students are trained to become analytical and consulting chemists. Under the auspices of the Institute, there are also training centres in the provinces.

The fees vary from about £100 in the country to £200 a year in the Metropolis ; and the course generally extends over three or four years. There are three examinations, the preliminary, the intermediate and the final ; and Borough Analysts, Public Analysts, Works Chemists and Technical Consulting Chemists are recruited from among the students.

Lady Chemists and **Dispensers** are becoming much more common, and girl students may qualify in much the same way as youths, a preliminary examination being necessary, or the production of satisfactory educational certificates, and registration with the Pharmaceutical Society. Then a period of apprenticeship ensues, to be followed by the qualifying examinations.

The Association of Women Pharmacists, Gordon Hall, Gordon Square, London, W.C., will supply a list of qualified women pharmacists and chemists willing to take apprentices ; and it should be remembered that not only are more and more women opening chemist's shops and taking over existing businesses, but there is a demand for qualified women as employees in chemists' premises and in the dispensing sections of the multiple-shop companies.

Chiropody.—People are finding that the care of the feet is becoming increasingly important.

At the present time, anyone may set up in practice as a chiropodist, but it is hoped by the authorities that in the near future people may be prevented from practising without an official diploma from the National Society of Chiropodists, whose headquarters and clinic are at 1 *Silver Street, Bloomsbury, London, W.C.*1.

The entrance fee to the National Society is four guineas and members pay an annual subscription of two guineas.

Veterinary Surgeons are appointed under the licence of the *Royal College of Veterinary Surgeons, Camden Town, London, N.W.* ; and no one may legally practise without the diploma of this College.

To become a veterinary surgeon it is of course essential that the candidate shall possess an inborn love of animals. He commences his technical training at sixteen years of age by entering a veterinary college ; and, in many respects, his education will run along the lines of the ordinary medical practitioner—lectures and classes, practical demonstrations and hospital work, operations and the close study of animal anatomy.

Veterinary surgeons are called upon to pass four examinations ; and not fewer than four years must be devoted to the training.

Details of the R.A.V.C. are obtainable from the War Office. The surgeons on appointment receive Army commissions.

A. C. M.

BOOK-KEEPING.—XXII

On p. 508, Vol. I., we saw that a wise trader will know that there is a possibility that some of his debtors may fail to meet their obligations. Hence, if he allows his sundry debtors to appear in the Balance Sheet at the figure shown in his books he may be unduly inflating his assets and so misrepresenting his position. He should therefore go carefully through the debtors' accounts and from his experience estimate the possibility of recovering them or not, compiling a special list of those which are doubtful. As these cannot be relied upon, they should not be considered as Assets but should be deducted from the Debtors.

Reserves for Bad Debts

In a large business it is not always possible to fix on the doubtful debts with certainty, but experience shows that the total of debts not recovered in any given year bears a fairly constant proportion to the total debtors at the beginning of the year, say 5 per cent. or 10 per cent., depending on the particular business.

Careful note should be made that the percentage should be based on outstanding debts, and not on sales, as sales include cash transactions.

When provision of this kind is made, a reserve is said to be created. It is a different matter from deducting bad debts. When bad debts are written off from sundry debtors a " Bad Debts Account " is opened,

and this is closed at the end of the financial period by transferring the total amount to the debit of Profit & Loss. When a reserve is created it is necessary to have a Bad Debts Account and a Bad Debts Reserve Account. There are two methods of creating a reserve either by :—

(i). Debiting the amount of the reserve direct to Profit & Loss and crediting Bad Debts Reserve Account ; or

in the books as due from various debtors are subject to discount the total in the Balance Sheet will not represent the assets of the business. Some businesses therefore reserve for Discounts both receivable and allowable. The reserve for Discounts allowable will be on Total Debtors less Bad Debts Reserve or Bad Debts, as the case may be, since discount is *not* allowed on debts not paid. The entries would be :—

JOURNAL :								
Profit & Loss .. .. .. *Dr.*				–	–	–		
To reserve for discount on Debtors							–	–	–
Being — per cent. of £00 0s. 0d. less old reserve of £00 0s. d.									

(ii). Debiting the amount of the reserve to the Bad Debts Account and crediting Bad Debts Reserve Account.

If the reserve is posted to Bad Debts Account as a credit balance it is misleading in preparing the Trial Balance.

The method of dealing with the Bad Debts Account and the *Old* and *New* Reserves will be seen in a later exercise embodying these matters.

The " Discounts Allowed Account " is balanced by transfer to Profit and Loss.

The " Reserve for Discount on Debtors Account " is credited with the old reserve as a balance brought down, and with the new reserve less the old reserve, which amount is transferred to Profit & Loss, the amount of the new reserve being carried down. The Profit and Loss Account shows as debit entries :—

To Discounts allowed							–	–	–
,, Reserve for Discount on Debtors				–	–	–			
Less old reserve				–	–	–	–	–	–

In the Ledger (i) Bad Debts Account is closed by transfer to Profit & Loss, (ii) the old and new reserves are adjusted between

and the Balance Sheet on the assets side gives the following entries relative to these matters :

Sundry Debtors				–	–	–			
Less Bad Debts Reserve				–	–	–			
				–	–	–			
Less Reserve for Discount				–	–	–	–	–	–

themselves (*see* page 247). Where the new reserve is in excess of the old reserve the balance is debited to Profit & Loss and credited to the Reserve. If the new reserve

The reserve for Discounts receivable will be the reverse and made up on the same lines ; that is, the Journal entries, if made, will be :—

Reserve for Discount on Creditors .. *Dr.*				–	–	–			
To Profit & Loss							–	–	–
Being — per cent. of £00 0s. 0d. less old reserve of £00									

is smaller than the old one the reverse process takes place, namely the Reserve is debited with the difference and Profit & Loss is credited.

Discounts

We have seen that reserves for Bad Debts are created in order that the total of sundry debtors in the Balance Sheet shall represent actual fact. Now if the amounts standing

Discounts " received account " is closed by transfer to Profit & Loss. Profit & Loss is thus credited with Discounts received and new Reserve less old Reserve.

If the old Reserve is greater than the new one the item becomes old Reserve less new Reserve, and is a debit balance.

On the liabilities side of the Balance Sheet we have :—

Sundry Creditors				–	–	–			
Less reserve for discounts				–	–	–	–	–	–

In an earlier lesson (page 54, vol. IV.), we have seen that general wear and tear is a charge against revenue, and as such is debited to Profit & Loss. We must now grasp the fact that decrease in value of machinery and plant may be due to other causes than use. The term used in relation to permanent and progressive decrease in value is the all-embracing one—*depreciation.*

Manufacturing firms have to face the possibility of new inventions so acting as to make the machinery in use out of date or obsolete ; again the value may be artificial owing to the existence of patent rights on the expiration of which the value must naturally fall. The fall in such cases in any financial period may be much more than is due to wear and tear ; it may even be that the machinery must be renewed. Consequently prudence demands a provision for depreciation over and above the provision necessary to meet repairs and the like.

Depreciation

Assets should be depreciated so that the value shown in the Balance Sheet may be approximately the true value. The amount is rightly charged against income, as generally depreciation is caused by income earning; further, by means of depreciation the asset may be replaced when necessary without the necessity of raising new capital. It would, however, be unfair to charge the renewal of assets against the current Revenue only. Various methods of depreciating assets are in vogue, and various proportions according to the nature of the asset are written off in each financial period.

Thus :—

1. A fixed instalment, say 10 per cent. of the original value, may be written off yearly ; or

2. A fixed percentage on the diminishing value may be written off yearly.

In case 1 the value of the asset is wiped out in ten years, but in case 2 the value is never wiped out, but in course of time the machinery or plant in question is represented by a *scrap value* only.

3. A re-valuation may take place, in which case a decrease in value will be debited to Profit & Loss, and the Asset Account will be credited. The Profit & Loss Account would be credited if the asset had appreciated in value, e.g. investments. Stock will be taken of loose assets, such as loose tools, packing cases, and the like. Horses are also depreciated by this method, and investments follow the same treatment.

4. *A depreciation fund* may be raised, the particular asset or assets remaining on the books at original value and shown in the Balance Sheet at this value, or at this value less amount of the fund.

The depreciation fund method is of considerable importance, as it may be used not only as a means of replacing depreciated plant and machinery but also as a means of spreading the cost of renewing leases over the period in which the old lease is operative, and it is also used as a means of charging the repayment of debentures equitably, against the various successive financial periods which benefit by the use of the money advanced by debenture holders. Something more will be said on such *Sinking Funds* in a later lesson.

A fixed amount is invested annually, and allowed to bear interest. Capital and interest remain untouched until required. The investments are then sold out and the cash used to replace the assets.

By means of tables specially prepared for the purpose it is possible to say what sum must be set aside yearly at a given rate of interest to provide £1 in a given number of years. From *Inwood's Tables* (29th Edition, page 112) we find that £·180975 invested every year for five years at 5 per cent. compound interest produces at the end of the fifth year the sum of £1.

Hence £2,000 will be produced by the investment each year of

£·180975 × 2,000 at 5 per cent. for 5 years = £361·95 = £361 19s. would be invested to replace at the end of five years an asset worth £2,000. (See example below).

Depreciation Investments

The same end would be achieved by putting aside £400 a year for five years, but this would be a wasteful process if interest was not invested as it accrued. The investment should be *outside* the business, so that it could be realised as required without interfering with the business.

As an *investment* the amount is shown each year as an asset in the Balance Sheet, the *fund* being a liability on the liability side or deducted from the value of the asset.

Consider the following example :—A certain asset will be valueless at the end of five years. It now stands at £2,000 as new property in the books of the business. It is desired to write the amount off and raise a depreciation fund by investment at 5 per cent. compound interest. We will write up the Ledger Accounts which may be raised as follows :—

Dr. BAD DEBTS. *Cr.*

19..		£ s. d.	19..		£ s. d.
Dec. 31	To Sundry Debtors	210 – –	Dec. 31	By Profit & Loss ..	210 – –

Dr. BAD DEBTS RESERVE. *Cr.*

19..		£ s. d.	19..		£ s. d.
Dec. 31	To Balance c/d ..	346 – –	Jan. 1	By Balance	180 – –
			Dec. 31	,, Profit & Loss ..	166 – –
		£346 – –			£346 – –
			19..		
			Jan. 1	By Balance b/d ..	£346 – –

Dr. DISCOUNTS ALLOWED. *Cr.*

19..		£ s. d.	19..		£ s. d.
Dec. 31	To Sundries ..	125 10 –	Dec. 31	By Profit & Loss ..	125 10 –

Dr. RESERVE FOR DISCOUNT ON DEBTORS. *Cr.*

19..		£ s. d.	19..		£ s. d.
Dec. 31	To Balance c/d ..	155 14 –	Jan. 1	By Balance	150 – –
			Dec. 31	,, Profit & Loss ..	5 14 –
		£155 14 –			£155 14 –
			19..		
			Jan. 1	By Balance b/d ..	£155 14 –

Dr. MACHINERY AND PLANT. *Cr.*

19..		£ s. d.	19..		£ s. d.
Dec. 31	To Balance ..	2,600 – –	Dec. 31	By Profit & Loss ..	195 – –
				,, Balance c/d ..	2,405 – –
		£2,600 – –			£2,600 – –
	To Balance b/d ..	£2,405 – –			

Dr. DEPRECIATION FUND ACCOUNT. *Cr.*

		£ s. d.			£ s. d.
1st year	To Balance c/d ..	361 19 –	1st year	By Profit & Loss..	361 19 –
2nd year	To Balance c/d ..	741 19 11	2nd year	By Balance b/d ..	361 19 –
				,, Cash (Interest)	18 1 11
				,, Profit & Loss..	361 19 –
		£741 19 11			£741 19 11
3rd year	To Balance c/d ..	1,141 – 11	3rd year	By Balance b/d ..	741 19 11
				,, Cash (Interest)	37 2 –
				,, Profit & Loss..	361 19 –
		£1,141 – 11			£1,141 – 11
4th year	To Balance c/d ..	1,560 – 11	4th year	By Balance b/d ..	1,141 – 11
				,, Cash (Interest)	57 1 –
				,, Profit & Loss..	361 19 –
		£1,560 – 11			£1,560 – 11
5th year	To Balance c/d ..	2,000 – –	5th year	By Balance b/d ..	1,560 – 11
				,, Cash (Interest)	78 – –
				,, Profit & Loss..	361 19 1
		£2,000 – –			£2,000 – –

Dr. DEPRECIATION FUND INVESTMENT ACCOUNT. *Cr.*

		£	s.	d.			£	s.	d.
End of 1st year	To Cash (Instal.)	361	19	–	1st year	By Balance c/d ..	361	19	–
2nd year	To Balance b/d ..	361	19	–	2nd year	By Balance c/d ..	741	19	11
	,, Cash (Instal. and Interest) ..	380	–	11					
		£741	19	11			£741	19	11
3rd year	To Balance b/d ..	741	19	11	3rd year	By Balance c/d ..	1,141	–	11
	,, Cash (Instal. and Interest) ..	399	1	–					
		£1,141	–	11			£1,141	–	11
4th year	To Balance b/d ..	1,141	–	11	4th year	By Balance c/d ..	1,560	–	11
	,, Cash (Instal. and Interest) ..	419	–	–					
		£1,560	–	11			£1,560	–	11
5th year	To Balance b/d ..	1,560	–	11	5th year	By Cash	2,000	–	–
	,, Cash (Instal. and Interest) ..	439	19	1					
		£2,000	–	–			£2,000	–	–

Dr. PARTICULAR ASSET ACCOUNT. *Cr.*

		£	s.	d.			£	s.	d.
Beginning of 1st year	To Cash	2,000	–	–	End of 5th year	By Depreciation Fund Account ..	2,000	–	–

The investment with interest will be realised at the end of the fifth year, and the total amount will suffice to replace the asset. The Depreciation Fund Account will appear as a liability in the Balance Sheet or as a deduction from the asset on the assets side, whilst as both asset and investment are co-existent during the five years both will appear on the assets side of the Balance Sheet thus at the end of the third year :—

Liabilities.	£	s.	d.	Assets.	£	s.	d.
Depreciation Fund	1,141	–	11	Particular Asset ..	2,000	–	–
				Depreciation Fund Investment ..	1,141	–	11
Or							
				Particular Asset £2,000			
				Less Depreciation Fund £1,141-0-11	858	19	1
				Depreciation Fund Investment ..	1,141	–	11

This leaves a balance in favour of assets of £2,000 in either case. The last method is the correct one, as the asset is shown properly depreciated.

Definitions of Terms

Reserves are made to meet future contingencies, e.g. Audit Fee, Bad Debts, Discounts, Rent accrued but unpaid. Sometimes a reserve is an addition to profits, e.g. a reserve for Discount on Creditors.

Goodwill, often the most valuable part of partnership property, may be written off, and if it has any real value the effect is to provide a reserve, as the writing off is a charge against Profit & Loss, and really may be said to be an appropriation of profits.

F. H.

GOLD AND QUARTZ.

1. Native gold in veined quartz. 2. Native gold in ferruginous veined quartz. 3. In quartz, without veining. 4. Telluride of gold and silver in quartz. 5. Nugget of gold. 6. Native gold, accompanied by decomposed iron pyrites, in quartz. 7, 8, 9, 10, 11, 12. Other forms of gold deposit.

Continued from page 188.

ENGLISH LANGUAGE AND LITERATURE:

Contributors:—ENGLISH LANGUAGE (W. A. Craigie, M.A., LL.D.; E. W. Edmunds, M.A.). ENGLISH LITERATURE (John Derry, J.P.). PHILOSOPHY (E. H. Tripp, Ph.D.). POLITICAL ECONOMY (J. W. Urwin). ETHICS (W. H. Koebel). PUBLIC SPEAKING (J. W. Urwin).

PHILOSOPHY.—VI

WE have already seen (pp. 185–188) that every event is preceded, or attended by, antecedent or concomitant events and conditions, one or more of which may determine its occurrence, i.e. be its "cause"; that causation as a rule connotes invariability of succession; and that such succession is attended by transference of energy. We have now to apply these considerations to the relationship between mind and matter, assuming, as hitherto, that they are diverse in nature.

Acts of Will

Do physical and psychical events follow one another in invariable sequence? Can we say of two events, if A is, then B is, one of them being physical and the other mental? Let us proceed by taking a few concrete examples.

Is the perception of a particular odour invariably consequent on the proximity of, say, chloroform? Is the striking of a dinner gong a determining factor in the sound we hear when it is struck? And is the striking of the gong invariably dependent upon the act of will of the striker? How is the sensation of sight related to the incidence of certain rays of definite wave-length? If we plunge a hand into boiling water, do we invariably feel heat and pain? And does immersing it in cold water always give us the sensation of cold?

These and an endless series of other similar questions must all be answered in the affirmative, and students of physiology will know that all the sequences mentioned entail changes of energy. It may be noted that the causal sequence A → B does not always imply energy transference in that direction; it may equally well take place in the direction B → A, so that the idea of compulsion or enforcement between cause and effect as determined by a flow of energy in that direction is untenable.

The question as to whether the human will can act as a cause is a very old one, and if our definition of causation be accepted it can only be answered affirmatively. It cannot be denied that an act of will is a determining factor in the movement of our body as a whole, or of certain parts of it, or, within limits, of external objects; and *vice versa*, a movement or event in our environment may determine a particular state of consciousness. Hence the causal relation may obtain between physical and mental phenomena. (Theory of Interaction.)

We have seen that the exercise of conscious volition was very probably the origin of the common view, held to be untenable, that a cause is an active agent which enforces an effect. This view, together with the circumstance that will plays a large and important part in our life, has led some thinkers to affirm that Will or Volition is the fundamental reality, and on this assumption, evolve a theory which purports to "explain" existence.

The Consciousness of Man

Apart from the fact that it appears to be stretching the imagination very far to *read into* the whole of nature that which experience has shown to be present in but a very small, if very important, part of it, viz., the consciousness of men and of some higher animals, it will be clear that this effort at interpretation leaves us very much as we were.

The earliest Greek philosophers, Thales, Anaximenes, Pythagoras, endeavoured to plumb the same abyss by postulating water, air, and number, respectively, as the one

and only cause and underlying essence. In common with a later school of volitionists, they held that the observable sequences in nature were inconceivable without the existence of some universal agent to establish a connection between them; but to us, water, air, number, will and the rest, however important they may be, fail to throw any light upon the *why* of phenomena and the reason of their unceasing and undeviating progression.

Not only do we find it impossible to realise why the sensation of warmth should follow the incidence of solar radiation upon our bodies, but it is equally impossible to understand the *why* of material sequences, as e.g., why the same radiation should condition the evaporation of water. As we have seen, the laws of nature provide no explanations, they merely summarise the actual facts: and the simplest facts are, in their ultimate essence, as unintelligible as the most complex. The statement may appear dogmatic, but it seems in the highest degree doubtful if human knowledge will ever attain the sublime heights o such explanation. Therefore, in the words of Goethe, it should be the highest happiness of a thoughtful man to investigate that which is capable of investigation, and to revere in silence that which is beyond comprehension.

Psycho-physical Parallelism

We must now revert to that theory of the relation of mind to matter called psycho-physical parallelism, which was alluded to on p. 126 as a direct corollary to the doctrine of Spinoza. As its name implies, it asserts that physical and mental phenomena are independent of one another; each forms a continuous series of its own, "gangs its own gait" but marches parallel with the other. If A, B, C, D,..... represent physical events and α, β, γ, δ ..... psychical events, then when A happens α happens, when β occurs B also occurs and so on.

We may represent these events as occurring in two parallel series as follows:—

A—B—C—D.....

α—β—γ—δ.....

The keynote of the parallelist position is that there is no interaction between the two series, or, in common language, that physical events never stand to psychical events in the relation of cause and effect, and vice versa, this relation implying that when one of them happens there is nothing in the nature of compulsion which makes the other take place, and no transfer of energy from the antecedent to the consequent. On p. 187 the notion of compulsion as between cause and effect was ruled out of order; therefore, so far as this point is concerned, we may agree: but it will be shown in a subsequent lesson that there is substantial evidence that mental and physical processes are attended by energy transformations.

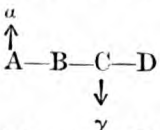
Further, we have just concluded that the causal relation, as defined by us, does hold for mind and matter. The denial of interaction by the parallelists is mainly founded upon the contention that its acceptance leads to consequences which are irreconcilable with the law of the conservation of energy: they would allow that the interaction theory has been of the greatest service to physiology and to mental pathology, but would not on that account admit it to be true, and would compare its utility with that of the atomic and molecular hypotheses, which have been most successful "working hypotheses" in the hands of chemists and physicists, but whose "objective" truth has not yet been established.

Epiphenomenalism

The position taken up by Huxley was an intermediate one. In his essay on *Animal Automatism* he expre sed the conviction that all states of consciousness in men and animals are caused by material changes in the brain-substance, and that there is no evidence that any state of consciousness is in itself the cause of changes or movements in the organism; or, as we should say, energy passes from the external world to the brain, but not from the brain to the external world—matter influences mind, but mind has no causative effect on matter.

Hence he regarded the phenomena of consciousness as simply the symbols of material changes taking place automatically in the organism. The feeling of pain we experience when a needle pricks the skin he would have called a "collateral product," an epiphenomenon, just as "the steam-whistle which accompanies the work of a locomotive engine is without influence on its machinery."

Adopting the method of representation used above, the epiphenomenalist would regard the relationship between physical and mental events as follows:—



The mental events (B, γ) never give rise to

physical or material events (A, B, etc.), they merely accompany certain of them, and there is no causal connection between them. Thus the state of consciousness called "will" which, in common parlance, makes me raise my arm is not to be regarded as the cause of the movement of that limb, but rather as a concomitant to the true cause—the particular state of the brain-substance which precedes the act. The consequence of this view is that all living organisms are to be regarded as automata; but, said Huxley, human beings and certain of the higher animals are to be differentiated from the rest inasmuch as they are "conscious automata."

The epiphenomenalist position appears to be better reconcilable with the facts of physiology than the purely parallelist doctrine; however, it leads to conclusions which reflect upon its tenability. Thus, e.g., it would be impossible to distinguish a conscious automatic animal from an unconscious one, since the behaviour of both would be identical—each would react in exactly the same way to the same external stimulus. It also negatives the possibility of the existence of a "free" will.

Neurosis and Psychosis

To discuss this proposition from the point of view of nerve-action (neurosis) and consciousness (psychosis), let us take the case of a person hearing a sound. Physics and physiology tell us that the vibrations of the sounding body are transmitted to the surrounding air, that a number of waves is propagated in the air which when such strikes against the ear-drum sets up disturbances in the auditory nerve; that in transmitting the message to the brain the nerve-matter undergoes a series of changes: that when the brain receives the message material changes ensue and then consciousness or the sensation of sound is evoked. The series of physical phenomena consists of:

A. Vibrating body → B. Air-waves → C. Nerve-changes → D. Brain-changes.

The *known* mental phenomena corresponding to these are:—

α ? β ? γ ? δ sensation of hearing.

It is obvious that the correspondence or parallelism is very incomplete, the psychical events corresponding to A, B, and C being conspicuously absent. In order to make the mental series approximate to the physical series it is necessary to *assume* that a mental event takes place in the matter of the vibrating body, in the air and in the nerves, and that these hypothetical happenings change *pari passu* with the physical changes.

The assumption involved is a very important one and indeed is indispensable to the "parallel" theory; it may be tersely stated as follows: "All matter is the seat of some form of mind." It is included in the cosmological doctrine of "pantheism," but can be discussed apart from it. For want of a better name, we will call it "neo-animism," which recalls its connection with the "animism" described in Vol. III., p. 379.

Closely allied to, but not identical with, neo-animism is "hylozoism," the doctrine that all matter is alive, and of the two the latter is the more fundamental.

Before entering into a discussion of these questions it is again necessary to emphasise the distinction between that which is possible *in thought* and that which is possible from the standpoint of *experience*. The conceptually possible is dear to the heart of the speculative philosopher, but those who have been trained in the methods of experimental science realise the importance of always feeling the ground of experience underfoot, especially when imagination lures the gaze to the stars. Such comparatively simple concepts as horse, cart, fly, sugar are commonly called abstractions from experience. When we think of a fly we do not visualise mentally all its parts and qualities, but by a process of abstraction —a kind of induction—we sum these up in a single word.

The Problem of Hylozoism

Now from these concepts as units it is very easy to construct other concepts of a compound character, such as that of a flying horse, or of a fly made of sugar, but however possible such objects may be in thought, they quickly dissolve away into nothing when tested on the touchstone of experience.

Therefore in attacking such an intricate problem as that of hylozoism the first step must consist in appealing to experience in order to arrive at the meaning to be given to the terms "life" and "living," and when this has been accomplished, to determine to what extent the words can legitimately be applied to those objects of experience which are called lifeless or non-living. We shall not use the words "animate" and "inanimate" as they imply, at least etymologically, the doctrine of "soul" (animism), which, as stated, is not identical with that of hylozoism.

E. H. T.

From the painting by Andrew C. Gow, R.A.

THE TUMULT IN THE HOUSE OF COMMONS, 1628,

which followed the "remonstrance" drawn up as a result of the King's disregard of the Petition of Right. After a memorable scene, when the Speaker was held in the chair, Charles dissolved Parliament, imprisoned Sir John Eliot, and determined to rule in future without Parliaments—which he did for eleven years.

Continued from page 196.

HISTORY:

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BRITAIN'S STORY.—XII

[*The introductory chapter of* LORD MACAULAY'S "*History of England*" *has been adopted in this work to explain the development of the British race prior to* 1660. *But as Lord Macaulay's work was intended merely as a sketch, explanatory passages* (*printed in closer type*) *have been interpolated in order to meet the requirements of the student.*]

CHARLES I. had received from Nature a far better understanding, a far stronger will, a far keener and firmer temper than his father. He had inherited the political theories of James I., and was much more disposed than his father to carry them into practice. He was, like his father, a zealous Episcopalian. He was, moreover, what his father had never been, a zealous Arminian, and, though no Papist, liked a Papist much better than a Puritan.

It would be unjust to deny that Charles had some of the qualities of a good, and even of a great prince. He wrote and spoke, not, like his father, with the exactness of a professor, but after the fashion of intelligent and well educated gentlemen. His taste in literature and art was excellent, his manner dignified, though not gracious, his domestic life without blemish.

Charles I: His Character and—

Faithlessness was the chief cause of his disasters, and is the chief stain on his memory. He was, in truth, impelled by an incurable propensity to dark and crooked ways; and there is reason to believe that he was perfidious, not only from constitution and from habit, but also on principle. He seems to have learned from the theologians whom he most esteemed that between him and his subjects there could be nothing of the nature of mutual contract; that he could not, even if he would, divest himself of his despotic authority; and that, in every promise which he made, there was an implied reservation that such promise might be broken in case of necessity, and that of the necessity he was the sole judge.

And now began that hazardous game on which were staked the destinies of the English people. It was played on the side of the House of Commons with keenness, but with admirable dexterity, coolness, and perseverance. Great statesmen who looked far behind them and far before them were at the head of that assembly. They were resolved to place the King in such a situation that he must either conduct the administration in conformity with the wishes of his Parliament, or make outrageous attacks on the most sacred principles of the constitution. They accordingly doled out supplies to him very sparingly. He found that he must govern either in harmony with the House of Commons, or in defiance of all law.

—Relations with Parliament

His choice was soon made. He dissolved his first Parliament, and levied taxes by his own authority. He convoked a second Parliament, and found it more intractable than the first. He again resorted to the expedient of dissolution, raised fresh taxes without any show of legal right, and threw the chiefs of the opposition into prison.

When the King called his third Parliament he found the opposition stronger and fiercer than ever. He now determined on a change of tactics. Instead of opposing an inflexible resistance to the demands of the Commons, he, after much altercation and many evasions, agreed to a compromise which, if he had faithfully adhered to it, would have averted a long series of calamities.

The Parliament granted an ample supply. The King ratified, in the most solemn manner, that celebrated law, which is known by the name of *the Petition of Right*, and which is the second Great Charter of the liberties of England.

By ratifying that law he bound himself (1) never again to raise money without the consent of the Houses, (2) never again to imprison any person, except in due course of law, and (3) never again to subject his people to the jurisdiction of courts-martial.

But within three weeks it became manifest that Charles had no intention of observing the compact into which he had entered. The supply given by the representatives of the nation was collected. The promise by which that supply had been obtained was broken. A violent contest followed. The Parliament was dissolved with every mark of royal displeasure. Some of the most distinguished members were imprisoned: and one of them, Sir John Eliot, after three years of suffering, died in confinement.

Charles, however, could not venture to raise, by his own authority, taxes sufficient for carrying on war. He accordingly hastened to make peace with his neighbours, and thenceforth gave his whole mind to British politics.

Unparliamentary Government

Now commenced a new era. Many English Kings had occasionally committed unconstitutional acts: but none had ever systematically attempted to make himself a despot, and to reduce the Parliament to a nullity.

Such was the end which Charles distinctly proposed to himself. From March, 1629, to April, 1640, the Houses were not convoked. Never in our history had there been an interval of eleven years between Parliament and Parliament. Only once had there been an interval of even half that length. This fact alone is sufficient to refute those who represent Charles as having merely trodden in the footsteps of the Plantagenets and Tudors.

It is proved, by the testimony of the King's most strenuous supporters, that, during this part of his reign, the provisions of the Petition of Right were violated by him, not occasionally, but constantly, and on system; that a large part of the revenue was raised without any legal authority; and that persons obnoxious to the government languished for years in prison, without being ever called upon to plead before any tribunal.

For these things history must hold the King himself chiefly responsible. From the time of his third Parliament he was his own prime minister. Several persons, however, whose temper and talents were suited to his purposes, were at the head of different departments of the administration.

Thomas Wentworth, successively created Lord Wentworth and Earl of Strafford, a man of great abilities, eloquence, and courage, but of a cruel and imperious nature, was the counsellor most trusted in political and military affairs. He had been one of the most distinguished members of the opposition and felt towards those whom he had deserted that peculiar malignity which has, in all ages, been characteristic of apostates. He perfectly understood the feelings, the resources, and the policy of the party to which he had lately belonged, and had formed a vast and deeply meditated scheme which very nearly confounded even the able tactics of the statesmen by whom the House of Commons had been directed.

To this scheme, in his confidential correspondence, he gave the expressive name of Thorough. His object was to do in England all, and more than all, that Richelieu was doing in France; to make Charles a monarch as absolute as any on the Continent; to put the estates and the personal liberty of the whole people at the disposal of the crown; to deprive the courts of law of all independent authority, even in ordinary questions of civil right between man and man; and to punish with merciless rigour all who murmured at the acts of the government, or who applied, even in the most decent and regular manner, to any tribunal for relief against those acts.

A Standing Army

This was his end; and he distinctly saw that there was one instrument, and only one, by which this end could be attained. That instrument was a standing army.

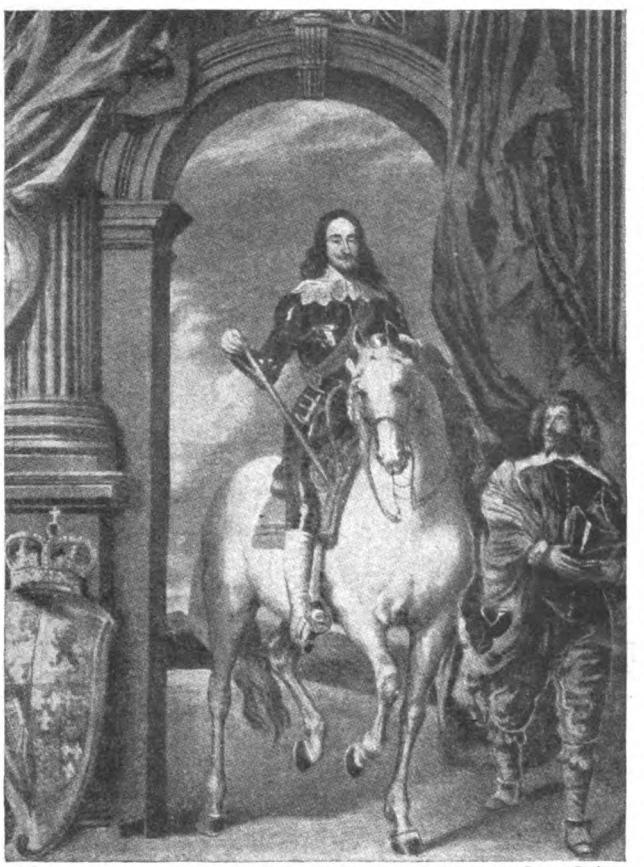
To the forming of such an army, therefore, he directed all the energy of his strong mind. In Ireland, where he was viceroy, he actually succeeded in establishing a military despotism, not only over the aboriginal population, but also over the English colonists, and was able to boast that, in that island, the King was as absolute as any prince in the whole world could be.

The ecclesiastical administration was, in the meantime, principally directed by William Laud, Archbishop of Canterbury.

Of all the prelates of the Anglican Church, Laud had departed farthest from the principles of the Reformation, and had drawn nearest to Rome. His theology was more remote than even that of the Dutch Arminians from the theology of the Calvinists. His passion for ceremonies, his reverence for holidays, vigils, and sacred places, his ill concealed dislike of the marriage of ecclesias-

tics, the ardent and not altogether disinterested zeal with which he asserted the claims of the clergy to the reverence of the laity, would have made him an object of aversion to the Puritans, even if he had used only legal and gentle means for the attainment of his ends.

But his understanding was narrow; and his commerce with the world had been small. He was by nature rash, irritable, quick to feel for his own dignity, slow to sympathise with the sufferings of others, and prone to the error, common in superstitious men, of mistaking his own peevish and malignant moods for emotions of pious zeal. Under his direction every corner of the realm was subjected to a constant and minute inspection. Every little congregation of separatists was tracked out and broken up. Even the devotions of private families could not escape the vigilance of his spies.



From the picture by Van Dyck at Hampton Court Palace.

KING CHARLES I. (1625-49).

Such fear did his rigour inspire that the deadly hatred of the Church, which festered in innumerable bosoms, was generally disguised under an outward show of conformity. On the very eve of troubles, fatal to himself and to his order, the Bishops of several extensive dioceses were able to report to him that not a single dissenter was to be found within their jurisdiction.

The tribunals afforded no protection to the subject against the civil and ecclesiastical tyranny of that period. The judges of the common law, holding their situations during the pleasure of the King, were scandalously obsequious. Yet, obsequious as they were, they were less ready and less efficient instruments of arbitrary power than a class of courts, the memory of which is still held in deep abhorrence by the nation.

Foremost among these courts in power and in infamy were the Star Chamber and the High Commission, the former a political, the latter a religious inquisition. Neither was a part of the old constitution of England. The Star Chamber had been remodelled, and the High Commission created, by the Tudors.

The power which these boards had possessed before the accession of Charles had been extensive and formidable, but had been small indeed when compared with that which they now usurped. Guided chiefly by the violent spirit of the primate, and freed from the control of Parliament, the government was able through their instrumentality, to fine, imprison, pillory, and mutilate without restraint.

A separate council which sat at York, under the presidency of Wentworth, was armed, in defiance of law, by a pure act of prerogative, with almost boundless power over the northern counties. All these tribunals insulted and defied the authority of Westminster Hall, and daily committed excesses which the most distinguished Royalists have warmly condemned.

The government of England was now, in all points but one, as despotic as that of France. But that one point was all important. There was still no standing army. There was, therefore, no security that the whole fabric of tyranny might not be subverted in a single day; and, if taxes were imposed by the royal authority for the support of an army, it was

probable that there would be an immediate and irresistible explosion.

This was the difficulty which more than any other perplexed Wentworth. The Lord Keeper Finch, in concert with other lawyers who were employed by the government, recommended an expedient, which was eagerly adopted. The ancient princes of England, as they called on the inhabitants of the counties near Scotland to arm and array themselves for the defence of the border, had sometimes called on the maritime counties to furnish ships for the defence of the coast. In the room of ships money had sometimes been accepted.

This old practice it was now determined, after a long interval, not only to revive but to extend.

Former princes had raised ship money only in time of war: it was now exacted in a time of profound peace. Former princes, even in the most perilous wars, had raised ship money only along the coasts: it was now exacted from the inland shires. Former princes had raised ship money only for the maritime defence of the country: it was now exacted, by the admission of the Royalists themselves, with the object, not of maintaining a navy, but of furnishing the King with supplies which might be increased at his discretion to any amount, and expended at his discretion for any purpose.

From the bust in the National Portrait Gallery. Photo: Emery Walker.

JOHN HAMPDEN (1594–1643),

who, in 1638, boldly stepped forward and disputed the King's right to levy Ship Money. A staunch parliamentarian, he died from a wound received at Chalgrove Field on June 18, 1643.

The whole nation was alarmed and incensed. John Hampden, an opulent and well born gentleman of Buckinghamshire, highly considered in his own neighbourhood, but as yet little known to the kingdom generally, had the courage to step forward, to confront the whole power of the government, and take on himself the cost and the risk of disputing the prerogative to which the King laid claim.

The case was argued before the judges in the Exchequer Chamber (1638). So strong were the arguments against the pretensions of the crown that, dependent and servile as the judges were, the majority against Hampden was the smallest possible.

Still there was a majority. The interpreters of the law had pronounced that one great and productive tax might be imposed by the royal authority. Wentworth justly observed that it was impossible to vindicate their judgment except by reasons directly leading to a conclusion which they had not ventured to draw. If money might legally be raised without the consent of Parliament for the support of a fleet, it was not easy to deny that money might, without consent of Parliament, be legally raised for the support of an army.

The decision of the judges increased the irritation of the people. A century earlier, irritation less serious would have produced a general rising. But discontent did not now so readily as in an earlier age take the form of rebellion.

The nation had been long steadily advancing in wealth and in civilisation. For seventy years there had been no civil war in England. Never, during the whole existence of the English nation, had so long a period passed without intestine hostilities. Men had become accustomed to the pursuits of peaceful industry, and, exasperated as they were, hesitated long before they drew the sword.

This was the conjuncture at which the liberties of the nation were in the greatest peril.

The opponents of the government began to despair of the destiny of their country; and many looked to the American wilderness as the only asylum in which they could enjoy civil and spiritual freedom.

There a few resolute Puritans, who, in the cause of their religion, feared neither the rage of the ocean nor the hardships of uncivilised life, neither the fangs of savage beasts nor the tomahawks of more savage men, had built, amidst the primeval forests, villages which are now great and opulent cities, but which have, through every change, retained

From the picture by William Fisk.

Westminster Hall during the trial of the Earl of Strafford, who was impeached in 1641, condemned to death, and executed on May 12th. A few years later—

From the picture by Alex Johnston.

—Archbishop Laud, the other faithful counsellor of Charles I., suffered a similar fate. After languishing for several years in the Tower without a trial, his case was heard in the House of Lords in 1644. Acquitted then of treason, he was condemned in 1645 by an ordinance of both houses.

some trace of the character derived from their founders.

New England

The government regarded these infant colonies with aversion, and attempted violently to stop the stream of emigration, but could not prevent the population of New England from being largely recruited by stouthearted and Godfearing men from every part of the old England.

And now Wentworth exulted in the near prospect of Thorough. A few years might probably suffice for the execution of his great design. If strict economy were observed, if all collision with foreign powers were carefully avoided, the debts of the crown would be cleared off: there would be funds available for the support of a large military force; and that force would soon break the refractory spirit of the nation.

At this crisis an act of insane bigotry suddenly changed the whole face of public affairs. Had the King been wise, he would have pursued a cautious and soothing policy towards Scotland till he was master in the South. For Scotland was of all his kingdoms that in which there was the greatest risk that a spark might produce a flame, and that a flame might become a conflagration.

Constitutional opposition, indeed, such as he had encountered at Westminster, he had not to apprehend at Edinburgh. The Parliament of his northern kingdom was a very different body from that which bore the same name in England. It was ill constituted: it was little considered; and it had never imposed any serious restraint on any of his predecessors.

But, though the Scottish Parliament was obsequious, the Scottish people had always been singularly turbulent and ungovernable. They had butchered their first James in his bedchamber: they had repeatedly arrayed themselves in arms against James II.: they had slain James III. on the field of battle: their disobedience had broken the heart of James V.: they had deposed and imprisoned Mary: they had led her son captive; and their temper was still as intractable as ever.

Whatever loyalty the nation had anciently felt to the Stuarts had cooled during their long absence. The supreme influence over the public mind was divided between two classes of malcontents, the lords of the soil and the preachers; lords animated by the same spirit which had often impelled the old Douglases to withstand the royal house, and preachers who had inherited the republican opinions and the unconquerable spirit of Knox. Both the national and religious feelings of the population had been wounded. All orders of men complained that their country, that country which had, with so much glory, defended her independence against the ablest and bravest Plantagenets, had, through the instrumentality of her native princes, become in effect, though not in name, a province of England.

In no part of Europe had the Calvinistic doctrine and discipline taken so strong a hold on the public mind. The Church of Rome was regarded by the great body of the people with a hatred which might justly be called ferocious; and the Church of England, which seemed to be every day becoming more and more like the Church of Rome, was an object of scarcely less aversion.

The government had long wished to extend the Anglican system over the whole island, and had already, with this view, made several changes highly distasteful to every Presbyterian.

The Scottish Covenanters

One innovation, however, the most hazardous of all, because it was directly cognisable by the senses of the common people, had not yet been attempted. The public worship of God was still conducted in the manner acceptable to the nation. Now, however, Charles and Laud determined to force on the Scots the English liturgy, or rather a liturgy which, wherever it differed from that of England, differed, in the judgment of all rigid Protestants, for the worse.

To this step, taken in the mere wantonness of tyranny, and in criminal ignorance or more criminal contempt of public feeling, our country owes her freedom. The first performance of the foreign ceremonies produced a riot. The riot rapidly became a revolution. Ambition, patriotism, fanaticism, were mingled in one headlong torrent. The whole nation was in arms. The power of England was indeed, as appeared some years later, sufficient to coerce Scotland: but a large part of the English people sympathised with the religious feelings of the insurgents; and many Englishmen who had no scruple about antiphonies and genuflexions, altars and surplices, saw with pleasure the progress of a rebellion which seemed likely to confound the arbitrary projects of the court, and to make the calling of a Parliament necessary.

To impose fresh taxes on England in defiance of law would have been madness. No resource was left but a Parliament; and in the spring of 1640 a Parliament was convoked.

Continued from page 212.

SCIENCES:

***Contributors*:**—ANTHROPOLOGY AND ETHNOLOGY (Sir H. H. Johnston, G.C.M.G., K.C.B.). ASTRONOMY (Arthur R. Hinks, M.A., F.R.S.). BOTANY (E. W. Edmunds, M.A., B.Sc.[Lond.]). CHEMISTRY (E. H. Tripp, Ph.D.). ELECTRICITY AND MAGNETISM (L. M. Parsons, M.Sc., D.I.C., F.G.S.). GEOLOGY AND MINERALOGY (Arthur Holmes, D.Sc.[Lond.], A.R.C.S., D.I.C., F.G.S.). PHYSIOLOGY (Sir Malcolm Morris, K.C.V.O., and D. W. Carmalt-Jones, M.A., M.D.(Oxon.]). SOUND, LIGHT, AND HEAT (E. W. Edmunds, M.A., B.Sc.[Lond.]). ZOOLOGY (E. A. Bryant and Ashley G. Brown, F.Z.S.).

SOUND.—VI

18. Reeds.—Some organ-pipes start their vibrations by means of a reed. This is a rectangular strip of metal fixed at one end and free at the other, which vibrates over an orifice which is generally a little larger than the reed; but the reed may also overlap the edge of the orifice slightly, when it is called a *beating reed*. In the organ-pipe the reed is arranged so that the blast of air blows alternately on either side of it; the compression returning to the orifice forcing it outward, and the rarefaction drawing it in again. The organ-pipe resounds to the tone given by the reed, which can be tuned by slight alteration of its length. In the clarinet and the oboe a reed is also used; it is set in vibration by the mouth, but the note of the tube dominates the reed and compels it to execute forced vibrations. In instruments of the trumpet class the lips drawn tight act as reeds, and the air in the tube resounds to its own note. By means of stops, the length of the tube is varied and a different note brought out. In the harmonium and the concertina the reed alone produces the sound: the stream of air necessary is probably to some extent connected with the frequency of the note emitted. The human voice, finally, is also a double reed acoustically speaking; the sound arises from the vocal cords which, by the action of the cartilages and muscles of the larynx, are brought close together and parallel, as well as tightened: the air from the lungs then sets them into vibration as it issues outward.

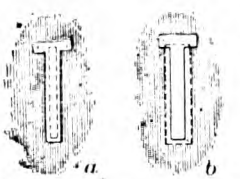


Fig. 51.—Two types of organ reed: *a*, the beating reed; *b*, the free reed. The dotted line indicates the orifice.

19. Kundt's Experiments.—A method, due to Kundt, of determining the velocity of sound in air or other gases, depends on the stationary waves made in a closed pipe. A B is a rod of metal or glass, clamped at the middle, and with the end A fitted into a cork which itself fits into the glass tube C D (Fig. 52). At D, a cork on the end of a rod can be pushed in and out of C D as a piston, so that the length of the air column enclosed in the tube can be regulated. A B is set into longitudinal vibration by means of a damp cloth or resined rag; its vibrations are communicated to the air in C D, which is thrown into stationary vibration like the air in a resonance-tube. The condition of the air can be revealed by sprinkling a little lycopodium powder through the tube before closing it. This powder is lifted up at the loops and whirled to the places of rest, i.e. the nodes, where it is deposited in little heaps. The distance between two of the heaps will be one half the wave-length of the note in air. If the length A D includes an exact number of half-wave-lengths the nodal heaps are very well defined, and this can be obtained by an adjustment of D. If the pitch of the note is known the velocity of sound in air can easily be calculated.

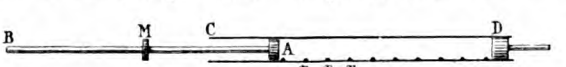


Fig. 52.—Illustrating Kundt's experiment to determine the velocity of sound.

Fig. 53.—To compare the relative velocities of sound in air and other gases.

The note given out by the metal or glass rod is, however, a very high one, and it is not easy to determine its pitch accurately. Kundt's experiment is therefore more frequently used to compare the velocity of sound in solids or other gases with that in air.

The wave-length in the rod is equal to twice its length (*see* Lesson IV), and for notes of constant pitch the velocity of sound is proportional to its wave-length. Hence we have:—

$$\frac{\text{Velocity of sound in rod}}{\text{Velocity of sound in air}} = \frac{\text{Length of Rod}}{\text{Distance between 2 heaps}}$$

If C D is filled with another gas than air, the distances between the successive heaps are now changed, but the comparative distances give the relative velocities of sound in air and in the gas. The apparatus is usually modified in order to make this comparison by the use of two tubes (Fig. 53). The rod is clamped twice—at a quarter and three-quarters of its length, and the central part of the rod is rubbed, so that it gives its first overtone. One end of the rod is fitted into an air tube, and the other into another tube containing the other gas.

20. Sensitive Flames.—Many examples of musical sounds result from friction, e.g. the passage of a rifle-bullet through the air, and the shrill note obtained when a file is used to sharpen a saw, may be mentioned. A little thought will enable us to understand why friction has the rhythmic character needed to set up vibration. Take the case of a violin bow drawn across the stretched string. Th bow has the passive resistance of friction to overcome; if it is used with a steady pressure, it will just overcome the friction, then be stopped by it, and again overcome it in rapid alternation; with the result that the string is set into vibration.

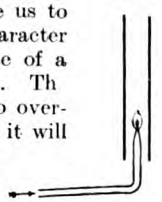


Fig. 54.—Musical Flames.

An interesting case in which friction plays such a part is that of musical flames. If a small jet of hydrogen be set alight, it burns with a small, almost invisible flame. If a glass tube about three-quarters of an inch wide be lowered over such a flame (Fig. 54), a point is reached when the flame gives out a distinct musical note. Lowering the tube still farther, we should notice that the note ceased for a time, only to yield the first overtone of the first note when the tube had been shortened sufficiently. It is evident that we have here, as in an organ-pipe, a case of resonance; from a confused flutter of vibration the tube selects the one with which it is in unison, and impresses that on the flame. The friction met with by the air drawn by the flame starts the vibration; the tube imposes regularity. By examining the flame during its singing in a moving mirror, it can be seen to be intermittent; instead of a continuous line of light a series of regularly disjointed images is seen, showing that the flame rises and extinguishes itself along with the vibrations. As Tyndall puts it, the flame twinkles like a star, with a frequency equal to that of the note. It is found that the note is to some extent dependent upon the size of the flame, but the length of the tube is the most important factor in deciding what the note shall be. The roaring of a flame in the chimney is doubtless a rude example of a singing flame.

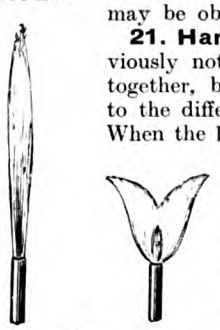


Fig. 55. — Naked flames are sensitive to sound under certain conditions.

If a flame is enclosed in a tube, as just described, but not singing, it quivers and sometimes goes out when a note in unison with that of the tube is sounded near it. If the note is slightly out of tune with that of the tube, the flame leaps up at each beat; this leaping ceases when the two notes are adjusted to harmony.

The above descriptions do not apply to naked flames; nevertheless a naked flame becomes sensitive under suitable conditions. When an ordinary fish-tail burner is turned on so that it is just on the verge of flaring, it will often shiver and become irregular when a high note is sounded near it. A burner with a circular orifice, connected with a gas-supply whose pressure can be regulated, gives more satisfactory results. The flame of such a burner, on the point of roaring, is long and tapering; when certain high notes are sounded, it becomes broad and roars (Fig. 55). The note of a whistle or the rattle of a bunch of keys causes a prompt response; if a passage of ordinary English prose be loudly read in its presence, the sensitive flame will respond to all the sibilant sounds. The effectual frequencies are those which synchronise with the vibrations produced by the friction of the gas at the orifice of the burner. It can be shown that the flame itself is not the seat of the sensitiveness which is at the orifice. The frictional vibrations there are forced into harmony with the effective note.

If this note be sounded opposite a firm screen so that its waves can be reflected, we can arrange the position of the sounding body in such a way that stationary waves are obtained in the air between it and the screen—the reflected waves interfering with the direct ones. The sensitive flame can then be used to show the position of the loops; at the nodes, the position of minimum motion, there is no response: only at the loops. If then the distance between two positions of maximum sensitiveness is obtained, we have half the wave-length of the note, from which its pitch may be obtained.

21. Harmony and Discord.—We have previously noted that when two notes are sounded together, beats are produced in frequency equal to the difference of frequency between the notes. When the beats are few and can be counted they are not unpleasing; but when they reach a frequency of 24 to 32 they cause that disagreement between the notes which we term discord or *dissonance*. Helmholtz declared that the worst discord results when the beats occur at about 32 per second, and that they cease to produce discord when they reach 80 per second.

When two notes are sounded together, it is in almost all cases possible to hear a third note with frequency equal to the difference between the frequencies of the primary tones. This note is called the first *difference tone*. It was formerly thought that this note was produced by the beats blending together to form a tone; there is a little difficulty about accepting this explanation, and possibly the effect is principally a physiological one. This is the more likely if it be true that a *summation tone* also exists, equal in frequency to the sum of the original; but many observers deny the existence of this tone. There is no doubt, however, about the first difference tone, and it is possible with suitable resonators to hear secondary difference tones formed between this and one or other of the primaries. The strength of the first difference tone

is such that it has an important influence on harmony.

Suppose the two notes C=256, and G=384 are sounded together. This is a harmonious interval, as is well known. While the two notes are sounding, a difference tone of frequency 384−256=128 will be formed. This is the octave below the original C, and therefore does not destroy the concord. But now suppose that C=256 is sounded with a note of frequency 528; the difference tone is of frequency 528−256=272, and this tone produces beats at the rate of 16 per second with the C; so that two notes of frequencies 256 and 528 will be discordant.

The matter is still further complicated by the fact that musical notes, as ordinarily obtained, are rarely pure, but are accompanied by one or more harmonics. The complete series of harmonics, with frequencies in the proportion of 1 : 2 : 3 : 4 : 5, is not usually found. In some instruments, like the trombone, the higher harmonics are exceptionally strong; in the closed organ-pipe the odd harmonics only are present; in the open pipe all the harmonics at the lower end of the scale occur; while in rods and bells the overtones are not in the harmonic series at all. It is obvious that the presence of these harmonics may modify harmony very considerably; partly by introducing new difference tones, and partly by being out of harmony with one another.

Let us take, for example, the melodious interval known as the fourth. The frequencies of these notes and their first four harmonics will then be as below:—

	Fund.	1st	2nd	3rd	4th Harmonics
Lower primary	$3n$	$6n$	$9n$	$12n$	$15n$
Upper „	$4n$	$8n$	$12n$	$16n$	$20n$

When $n=32$, the fundamental notes are G=96 and C=128 in the bass clef. The beats here are such as produce discord, and clearly that discord is enhanced by the presence of the same number of beats between the 2nd harmonic of G and the first of C, and also between the third of C and the fourth of G. But it is also clear that if we raise both notes an octave so that $n=64$, the harmonics do not collide offensively, and the interval becomes tolerably concordant. The given interval is not equally discordant at all parts of the keyboard. A semitone is usually a very discordant interval (16 : 15), but when both notes are high the discord is not so serious, e.g. C=1280 and B=1200 blend reasonably well.

When there are more than two notes in a chord the question of harmony is obviously more complex, irrespective of harmonics or difference tones. Suppose we have three notes X, Y, Z, such that the interval between X and Y is a fifth, and that between Y and Z is a major third (5 : 4). Will these notes be consonant or dissonant? It depends on the value of the interval X−Z. Now, $\frac{Y}{X}=\frac{3}{2}$ and $\frac{Z}{Y}=\frac{5}{4}$: hence $\frac{Z}{X}=\frac{15}{8}$, and this is not a consonant interval, because the octave of the lower note is only a semitone above the higher note. On the scale of C, the three notes given are C, G and B; in the middle of the piano, that will be a discordant chord.

Let us take another example. If the interval between X and Y is a major third, and that between X and Z is a fifth, is the chord harmonious or discordant?

$\frac{Z}{X}=\frac{3}{2}$ and $\frac{X}{Y}=\frac{4}{5}$; $\therefore \frac{Z}{Y}=\frac{6}{5}$. Thus the interval between Y and Z is a minor third which is harmonious. Hence the whole chord is harmonious.

22. Acoustical Instruments.—The quality of a musical note is determined by the nature of the harmonics which occur along with the fundamental note; and the presence of these harmonics can be detected by suitable resonators. Their effect on the actual vibration of the air particles can be recorded in a displacement diagram as explained in Vol. III., p. 402. The result is a curve of the same wave-length, but of different shape, from that given by the simple fundamental note alone. It is such a curve that is traced on the cylinder in Edison's *phonograph*, which in its modern improvements—the gramophone, Pathéphone, etc.—reproduces the quality of the original sound with remarkable success. Such failure as there is is due probably to the difficulty of restoring the slight irregularities established by some of the weaker harmonics.

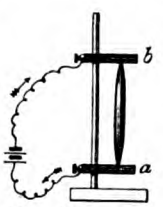


Fig. 56.—The essential features of the microphone.

In the phonograph, the sound is received on a membrane at the bottom of the conical receiving cone. On the other side of the membrane is a short pointed style which writes the vibrations of the membrane as a wavy line in a layer of firm wax on a revolving cylinder or disc. The cylinder is made to revolve spirally by means of a screw, so that the records do not overlap. On causing the cylinder to revolve at the same rate, the sound is reproduced at the same pitch; the style retraces the wavy line, and sets the membrane into vibrations, of the same nature and frequency as when it received the sound.

The *telephone* depends upon electric principles which cannot be fully discussed here. In the transmitter the sound was received by a membrane which vibrates in the field of an electro-magnet; the variations in the current thus induced are conveyed to a similarly constructed receiver, the steel membrane of which responds by its vibrations to the change in the current in the electro-magnet, thus reproducing the sound.

The transmitter in the original telephone of Graham Bell was like the receiver, but nowadays a different form of transmitter is used. This is based on the same principle as Hughes' *Microphone*, an instrument which responds to very slight vibrations.

The essential feature of this microphone is a spindle of carbon, fitting loosely into two carbon supports, *a*, *b* (Fig. 56). The spindle forms a "loose contact" at each of its supports, and if it is caused to vibrate the electrical resistance of the contact is changed. The consequent change in the current can, by electrical means, be made manifest in a telephone receiver. E. W. E.

ELECTRICITY AND MAGNETISM.—XVII

Induced Currents.—We found that magnetic properties could be induced in pieces of steel or iron without the inducing magnet coming in contact with the pieces of steel. The magnetic influence operated through a space occupied by air or some other non-magnetic substance such as glass, paper, wood, etc.

Any such body through which magnetic influence passes is called an inductive medium. The nature of the medium has a great deal to do with the inductive effects, some media permitting a greater effect than others. Since air is the medium present in connection with practical applications, we will reserve a comparison of effects produced when different inductive media are used for consideration in a later lesson dealing with static electricity.

When wires move about in a magnetic field electric current may flow along the wires, and such currents are said to be *induced*. The magnetic fields which induce these currents may be due to magnets or to other currents flowing along separate circuits, since wires conducting currents have their own magnetic fields. For the present we will consider induced currents produced by the influence of magnets. In performing the experiments which follow, we must bear in mind that our home-made apparatus is not as sensitive as instruments constructed by professional makers, but with care it may be possible for us to obtain some results. In any case the student should bear in mind the importance of statements printed in italics.

Experiment 55.—*To observe the inductive effects when a magnetic pole is plunged into and then withdrawn from a coil of wire.*

Arrange the coil of wire and astatic galvanometer as used in Experiment 22, Lesson VII. See that the coil and galvanometer are a considerable distance apart. Suddenly plunge the north pole of a bar magnet into the coil and observe the direction of the galvanometer movement. The quicker you plunge the magnet into the coil the better will be the effect. With the magnet stationary in the coil, allow the galvanometer needle to come to a state of absolute rest. Suddenly pull the magnet out of the coil, when the galvanometer should now move in the opposite direction, showing that the induced current flows in a direction opposite to that of the first. In moving the magnet about be careful to keep it away from the galvanometer, otherwise your results will be misleading.

Now try similar experiments, using a south pole instead of a north. Note your results carefully, and you will observe that the direction of the induced current when a north pole is plunged into the coil is the same as that of the current induced when a south pole is withdrawn from the coil, and vice versa. In addition to the important fact just stated, three other equally important results are obtained from the experiment.

(1) *When a magnetic pole is plunged into the coil a momentary current is induced in the coil.*

(2) *When the same pole is withdrawn a momentary current flowing in an opposite direction to that of the first is induced in the coil.*

(3) *As long as the magnet remains stationary in the coil no current is induced.*

The third fact must be carefully considered. Although the magnet is in the coil and its magnetic influence passes through the wires, *no current is produced unless motion takes place.* If we try many times with stationary magnets of considerable strength, the result will always be the same.

For the production of induced currents the magnetic influence extending through the wires must vary in intensity, and to cause this variation motion is necessary.

Induced currents as those produced by other means possess energy in virtue of which work may be performed, and such energy cannot be produced from nothing. The energy of induced currents is due to the mechanical work done in producing motion.

But does it matter which moves, the coil of wire or the magnet?

Experiment 56.—*To see if movement of the coil will produce induced currents when the magnet remains stationary.*

Employ the same apparatus as that used in the previous experiment, but hold the magnet above the table and thrust the coil of wire over its north pole. Note the direction in which the galvanometer moves. Allow the needle to come to rest, and then suddenly remove the coil without disturbing the magnet. Again observe the galvanometer movements.

The results are similar to those obtained from Experiment 55.

Obviously it does not matter which moves, the coil or the magnet, as long as one moves relatively to the other.

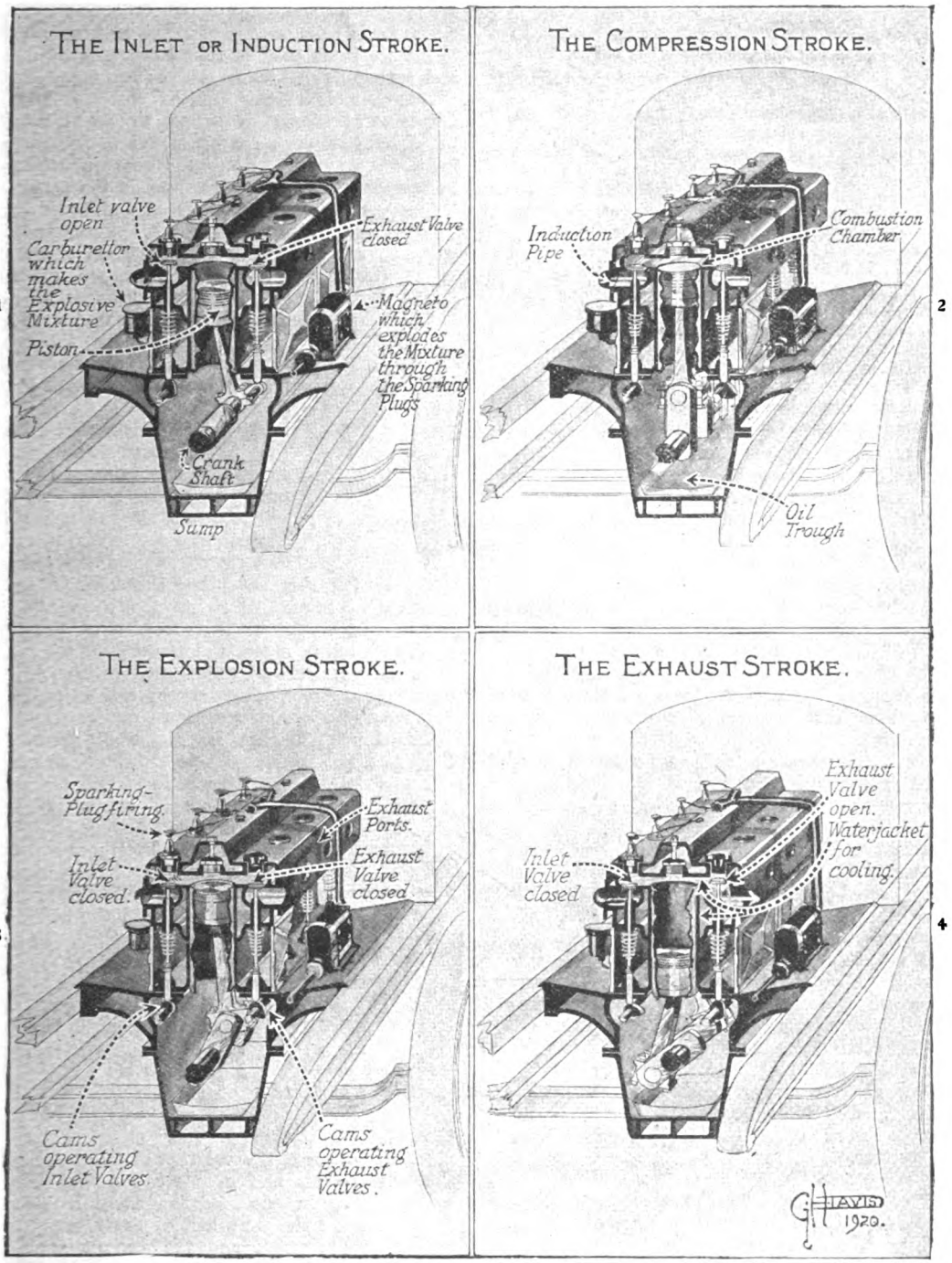
Suppose that we wished to make a machine to generate current electricity by the inductive influence of magnetism, how should we proceed? Certain facts are very clear. The machine must consist essentially of two parts: (1) a magnet and (2) a coil of wire, and one of these must move while the other remains stationary.

As to which of the two parts moves, the matter is one of convenience. Probably it will be easier to arrange an apparatus on which the coil of wires moves, and a great deal depends upon *how* it is to move. Other questions suggest themselves. The machine should supply a good and *continuous* current. A current produced by induction is the result of a definite electro-motive-force, just as a current obtained by any other means owes its existence to an E.M.F. To obtain a good current a good E.M.F. is required, and how is this to be obtained by induction?

Electro-Motive-Force of Induction.—What conditions determine the voltage of an induced electro-motive-force?

Experiment 57.—*To observe the factors which determine the E.M.F. of induced currents.*

Fit up the apparatus used in the last experiment. Plunge a magnetic pole *quickly* into the coil of wire and note the readiness with which the galvanometer needle responds to the induced current. Remove the magnet, allow the galvanometer to come to rest, and then *slowly* introduce the same magnetic pole into the coil. The galvanometer needle does not



Drawn by G. H. Davis.

A PETROL MOTOR SIMPLY EXPLAINED.

The petrol comes from the tank to the carburettor which mixes it with the correct quantity of air to render it explosive. 1. It is then sucked by the downward stroke of the piston into the combustion chamber. Inlet valve open, exhaust valve closed. 2. The piston comes up and compresses it. Both valves closed. 3. The sparking plug then gets to work and fires, exploding the mixture and making the power stroke. Both inlet and exhaust valves closed. 4. The piston ascends and drives the burnt gases through the exhaust valve which is now open.

respond so readily. The result must be due to a weaker current, and this shows that the E.M.F. must be lower since the resistance of the circuit remains the same.

Repeat the experiment, using a much more powerful magnet, say, an electric magnet made by turning some wire around a bar of soft iron. Observe the degree of readiness with which the galvanometer responds. The resistance of the circuit remains the same as before, but the stronger magnet produces better results. The induced E.M.F. is higher. The results in all cases will be feeble for reasons already stated. By substituting a coil of wire having many more turns than the first one, and by repeating the movements of the magnets, it will be found that the E.M.F. of induction is higher (i.e. of a higher voltage) the greater the number of turns of wire in the coil.

Assuming that it will be more convenient for the coil to move while the magnet remains stationary, let us summarise the results of the experiment:

The E.M.F. to which an induced current is due depends upon:

(1) *The rate at which the coil moves through the magnetic field.*

(2) *The number of turns of wire in the coil.*

(3) *The strength of the inducing magnetic field.*

In applying these facts to the construction of a machine, certain practical suggestions may be considered.

Why not mount a coil consisting of several turns of wire on a suitable axis, so that it can be rotated rapidly near the inducing magnet?

Could not a stronger magnetic field be obtained by using more than one magnet? The strength of the magnetic field might be increased by using electro magnets in place of permanent steel magnets.

The construction of machines called dynamos which generate what is usually called electric power for lighting, electric railways, etc., is based upon the employment of these suggestions.

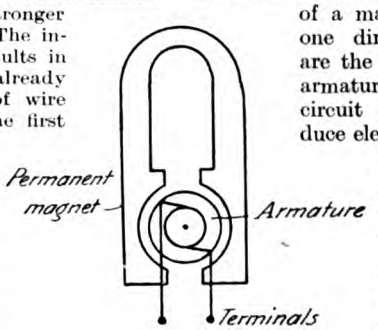


Fig. 60.—Section through a magneto.

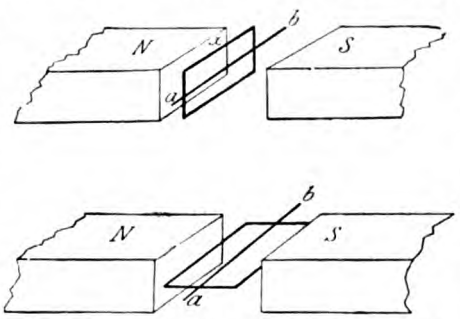


Fig. 61.—Explaining the action of a magneto.

The Magneto.—One of the simplest forms of induction machines is the magneto, which is used on motor-cars and cycles.

A permanent steel magnet of the "horseshoe" shape is so constructed as to leave a cylindrical space between the poles. In this space a suitably constructed coil of wire, consisting of many turns wound on an iron core, is rotated, the necessary power being obtained from the engine of the motor cycle or car. As the coil rotates currents are induced in its wires, and these can be taken off by means of a special device which is called a *commutator.*

The rotating coil is always called the armature, and the magnetic poles are termed FIELD MAGNETS, these terms are being used in connection with dynamos and motors as well as magnetos (Fig. 60).

We have seen that induced currents flow in different directions according to the direction in which the wires conducting them are moved in a magnetic field, hence the question arises as to whether the currents induced in the armature of a magneto or dynamo always flow in one direction or not. Further, how are the currents to be taken from the armature and sent along an external circuit to do the work such as to produce electric light, or move tram-cars?

Let us suppose that the armature consists of a simple wire hoop which can be rotated about an axis *a b*.

From our earlier work we know that the lines of force stream across the gap between the two unlike magnetic poles. As the coil is rotated in the space the hoop of wire cuts across the lines of force sometimes, and extends parallel with them at other times. The upper diagram in Figure 61 shows the hoop when it is at right angles to the direction of the lines of force flowing across the space.

In this position the greatest number of such lines of force pass through the wire hoop, and the magnetic field exerts its *maximum* influence on the armature.

The lower diagram in Figure 61 shows the hoop in a position parallel to the direction of the lines of force, and the magnetic field exerts its least influence.

As the hoop moves round the number of lines of force cut by it will become less and less until the horizontal position is reached. In passing through the next quarter of a rotation the hoop will cut through more and more lines of force until the position of maximum magnetic influence is reached.

The half of the hoop that was uppermost when the rotation started is now underneath. The result of this and the polarity of the magnets is that during this half of a rotation the induced currents flow in one direction around the wire hoop. During the next half of the rotation conditions are reversed, and the current generated in the hoop will flow in a direction opposite to that of the current flowing during the first half rotation.

The armatures of magnetos and dynamos are similar to the hoop with a small piece taken out and the free ends connected to an external circuit. Currents can flow only when this external circuit is attached.

The alternating currents in the armature are passed along the external circuit as a continuous current in one direction only, by an arrangement called a split-ring commutator. L. M. P.

BOTANY.—X

27. The Stem.—The stem is the axis of the shoot, on which the leaves and floral branches are borne. Sometimes, as in the dandelion, it is very short, so that the leaves seem to arise in a bunch from the root; but usually it is an elongated and vertical axis, bearing leaves at fixed intervals. We have already studied the arrangement of the leaves, and turn now to the stem itself.

Examine the stem of any annual plant, such as the shepherd's purse. It is green externally; but the green portion forms no more than a thin rind, called the *cortex*. This can be scraped off with a knife, when we come to the hard parts. These will be seen to consist of a series of longitudinal strands, disposed circularly around a soft internal tissue, the *pith*. The tough strands consist of vessels, continuous with those of the root, and formed into groups called *vascular bundles* (Fig. 56). These can be well seen when the stem is cut crosswise and examined with a lens. If other young stems be compared with the shepherd's purse, it will be seen that the ring of vascular bundles is usually very near to the surface, while the central space is as often as not empty and the stem consequently hollow. This arrangement of the strengthening strands gives the maximum of support, and enables the stem to recover itself completely when it is bent. The whole structure is more elastic than it would be if the vascular strands were irregularly distributed throughout. Nevertheless, in the stems of monocotyledons the vascular bundles are as a rule irregularly distributed, as may be seen in the stalk of a lily.

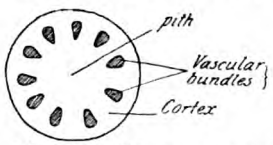


Fig. 56.—Diagram of the Stem of a Plant.

The young stem thus described is unchanged through the life of an annual; but if it is to be persistent, as in woody perennials it is, certain changes begin towards the end of the first summer. These changes result in the formation of the *wood* and the *bark*.

When we come to the microscopic examination of the stem, we shall learn that each vascular bundle shows three distinct portions, viz. the *xylem*, internally, consisting mainly of long vessels for water-transit; the *phloëm*, externally; and between them, a layer called the *cambium*, which has the power of growth. From the cambium layer, new xylem and new phloëm are formed, most actively in springtime, but steadily throughout the summer also. This increase of xylem corresponds with the increasing demand for water as growth continues.

At the same time increased support is needed owing to the greater weight of the upper parts; and this is obtained by the gradual change of the active xylem into compact, passive wood. The wood increases to such a degree as to obliterate almost all the pith, and at the same time to throw such strain upon the outside layers as to crack them in the manner which is familiar in such trees as the oak. The outer layers of the wood, known as the *alburnum* or sap-wood, still carry on the sap-carrying function; the inner heart-wood, or *duramen*, is dry and firm, and is, of course, the part of the tree which is valued as timber. An interesting feature of the duramen is the series of concentric annual rings. These result from the fact that the new xylem formed in the spring is more open and hence lighter than that formed in the autumn.

The boundary between this year's spring wood and last year's autumn wood is thus definitely marked; and each of the lines represents a year's growth.

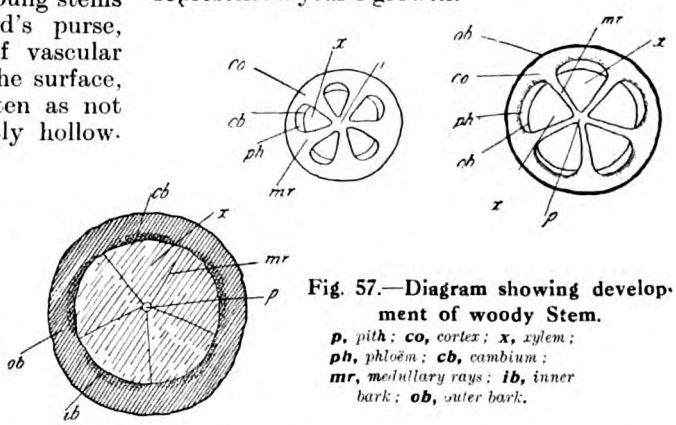


Fig. 57.—Diagram showing development of woody Stem.
p, *pith*; ***co***, *cortex*; ***x***, *xylem*; ***ph***, *phloëm*; ***cb***, *cambium*; ***mr***, *medullary rays*; ***ib***, *inner bark*; ***ob***, *outer bark*.

The phloëm is not so extensive as the xylem, either at first or at any time. As new phloëm forms from the cambium, the outer phloëm dies, and forms the stringy inner bark or *bast* of the adult tree. Both new phloëm and new xylem also form in the spaces between the vascular bundles, until only a radial streak remains, known as a *medullary ray*. Fig. 57 illustrates these changes diagrammatically.

The true bark of a tree is composed of cork and arises normally in the cortex. The cork-tissue is compact, air-tight and water-tight; it is also a bad conductor of heat, so that its use as a protective layer is manifest.

Cork is also formed over the surface of wounded portions of a stem, e.g. the leaf-scar left after leaf-fall is covered with a layer of cork. The bark is not, however, unbroken entirely ; it is important that air should enter the stem, and this is provided for by means of *lenticels*, which are practically little air-holes through the bark. They can easily be observed on young twigs as elevations a little smaller than a pin's head.

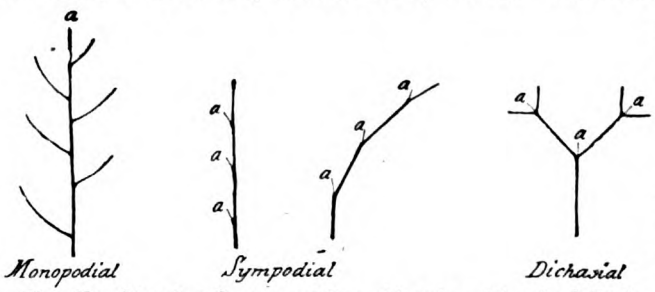


Fig. 58.—Showing System of Branching (*a* = Terminal Bud).

As the wood increases beneath it, the bark is subject to very considerable strain. To this strain it responds either by splitting and cracking, as in the oak or elm ; or by peeling off, as in the birch or plane. The silvery appearance of the trunk of the birch is due to the casting of the old bark and the constant exposure of that which has been newly formed.

The appearance presented by a tree-trunk when it is cut across can now be understood.

Examine for yourself the appearance presented when branches of the following are cut across: Lime, elder, ash, rose, hawthorn, birch, beech. In which of these are the pith, medullary rays, annual rings and bast respectively conspicuous ? Note the slimy layer on the outside of the wood: this indicates the position of the cambium.

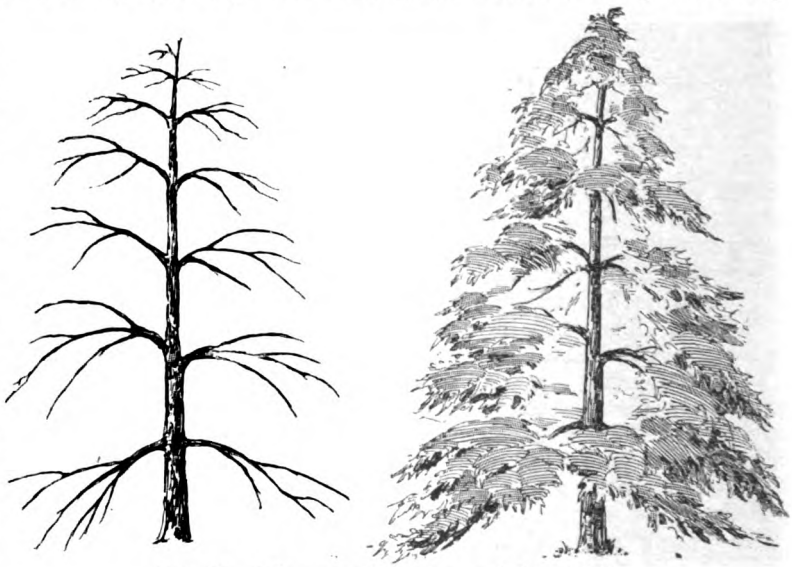


Fig. 59.—Diagram of Deodar or Indian Cedar.

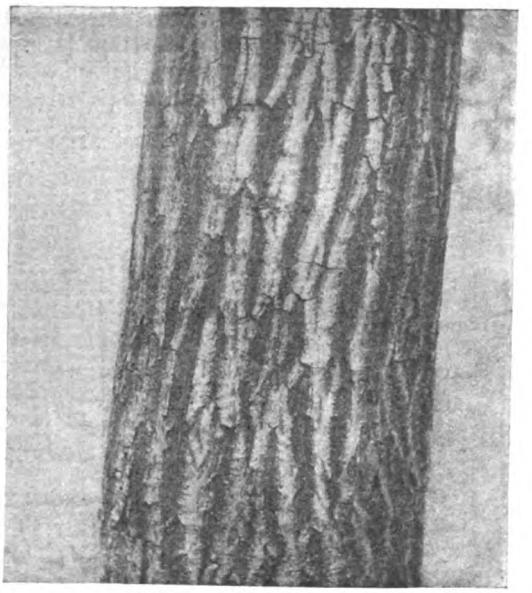
28. Buds and Branching.—The leafy shoot of a perennial, as we have already seen (Vol. III., p. 154), is always terminated by a bud, and lateral buds are to be found in the leaf-axils. When the buds develop, they form either new leafy branches or flower-bearing branches, or a combination of these. In the simplest type of development, the terminal bud grows more strongly than the lateral buds, and produces a continuation of the main axis with a new bud at the end of it. Such a form of branching, in which the lateral branches are distinctly inferior in development to the main axis, is spoken of as *monopodial*. The result is a symmetrical form of tree, giving a generally conical outline, as in pines or cedars (Fig. 59). But this is not the usual type. The terminal bud is often very small, and its development entirely swamped by that of one or two lateral buds immediately beneath it ; or it may end as a flower, and close its development when the flower dies. In either case, the main growth is continued into the lateral branches and the chief axis of the tree is thus compositely formed out of contributions from a succession of lateral buds. This is the *sympodial* method of branching, which is common to all our forest trees and shrubs, except the pine family (Fig. 58). In the lilac the simultaneous and almost equal development of two opposite lateral buds gives rise to an appearance of forking, called the *dichasial* system of branching (Fig. 58). In the sycamore and horse-chestnut, both monopodial and sympodial branching can be observed on different branches. The terminal bud in these instances usually produces an inflorescence, which leaves a conspicuous scar on falling.

The mature tree-trunk does not as a rule show any sign of its sympodial origin.

Some of them, indeed, have a pronounced monopodial appearance. Such trees tend to grow straight and tall, like the birch tree, and to have a comparatively subordinate system of side branches. On the other hand, the beech develops several subsidiary trunks, which spread outward and produce a very different general effect.

These habits are, of course, the result of the tree's conditions of life; they are very characteristic, and the student should study carefully the winter appearance of trees, making generalised sketches of their system of branching, like that of Fig. 59 on page 266. English trees are easily recognisable in winter.

A horse-chestnut twig bears at least six lateral buds, and if all these developed to their fullest extent without mishap for ten years, 6^{10} or 60,466,176 branches would be produced! Obviously this does not happen, and we must look for the mishaps. Several causes of these are possible. The bud may be injured or destroyed by animals, cold, or other accident. It may develop imperfectly or weakly, as a result of the deficiency of light or of nutrient materials. Or it may not develop at all, but remain dormant. Or, again, the twig itself may be deciduous, as in the case of the oak, which owes its gnarled appearance to the liberal falling of its twigs in autumn. These numerous causes effectively reduce the ideal development of the tree, so that it is only possible to read the original mode of branching of the tree on its smallest twigs.



Bark of a Walnut Tree. The true bark of a tree is composed of cork and arises normally in the cortex.

The silvery appearance of the trunk of the birch is due to the casting of the old bark and the constant exposure of that which has been newly formed.

Photos: B. Clarke Nuttall.

The bark of a plane peels in autumn owing to the increasing strain of the wood.

A dormant bud does not as a rule die. As the stem grows in thickness, the undeveloped bud develops so far as to keep its tip near the surface; it may continue growing thus for years, and so form a branch buried in the wood of the enlarging tree. In this way are produced the familiar knots of timber. Under proper conditions, moreover, the dormant bud will emerge and branch out at the surface. Any threat or injury to the upper branches will bring this about. When these are cut or pruned away, the tree is not killed; its dormant buds save it, and burst into full activity. The trunk of the elm always bears a typical outgrowth of young branches produced from buds that have long lain dormant.

The effect of the stunted development of branches can be well seen in trees which are

exposed to cold winds. The branches on the north side of such trees are smaller, and their foliage is more scanty than those on the sunny side.

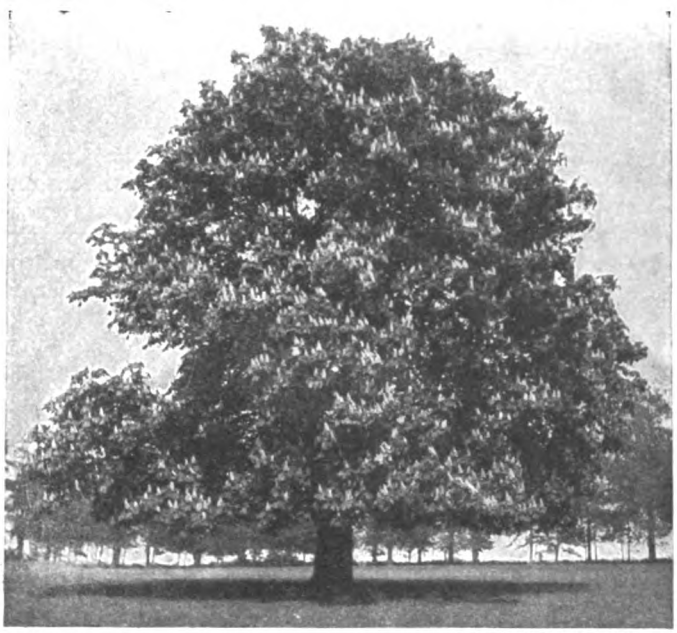


Photo: B. Clarke Nuttall.

A horse-chestnut twig bears at the base six lateral buds. If all these developed, in ten years some sixty million branches would be produced.

29. Structure of a Bud.—The structure of a bud should be examined in the first instance in brussels sprouts, in which no magnification is necessary. It will then be seen to be an overlapping series of leaves growing out of a conical axis. The outer leaves are fully developed, and the leaves become smaller and less perfect as we proceed inward. Inside, where there is very little room, the leaves are folded in such a manner as to economise space as much as possible.

In the very simplest terms, therefore, a bud is no more than the conical growing point of the stem, surrounded by a series of leaves in various stages of development. When it begins to grow in the spring, all that happens is that the short internodes lengthen ; the leaves are thus forced apart, and expand while the very youngest ones remain as a protection for the growing-point—forming, that is, another bud.

We shall have to study buds a little more closely, however, later, and we shall then find that this very interesting subject has been much complicated by the very high degree of specialisation shown by certain plants such as the horse-chestnut buds. E. W. E.

Photo: B. Clarke Nuttall.

The trunk of the elm always bears a characteristic outgrowth of young branches produced from buds that have long lain dormant.

MINERALOGY.—II

14. Properties of Minerals.—As a preliminary to the description and determination of minerals it is necessary to acquire a knowledge of some of the more important properties of minerals. The two most fundamental characters of a mineral, and by which it is completely defined, are its crystal form and its chemical composition. The former of these has been dealt with already; the latter is discussed below. Depending on these are a number of other characters which are often of the greatest value in recognising minerals. These will be described under the following headings :—

Habit, Form of Crystal Aggregates, Structure of Crystal Aggregates, Fracture, Cleavage, Hardness, Lustre, Colour and Streak, Specific Gravity.

15. Composition of the Earth's Crust.—A large number of chemical analyses, extending to many thousands, have been made during the last few decades of rock specimens from all parts of the earth's surface. It is therefore possible to state with considerable accuracy the average composition of the earth's rocky crust (the litho sphere) as far as it is available to our investigation and study. In the following table this average is expressed in percentages of elements (I.) and of their oxides (II.).

Average Composition of the Lithosphere

I. *Elements*			II. *Oxides, etc.*	
Oxygen	O	47·17		
Silicon	Si	28·00	SiO_2	59·85
Aluminium	Al	7·84	Al_2O_3	14·87
Iron	Fe	4·44	Fe_2O_3	2·63
			FeO	3·35
Calcium	Ca	3·42	CaO	4·81
Magnesium	Mg	2·27	MgO	3·77
Sodium	Na	2·43	Na_2O	3·29
Potassium	K	2·49	K_2O	3·02
Hydrogen	H	0·23	H_2O	2·05
Titanium	Ti	0·44	TiO_2	0·73
Carbon	C	0·19	CO_2	0·70
Chlorine	Cl	0·06	Cl	0·06
Fluorine	F	0·10	F	0·10
Phosphorus	P	0·11	P_2O_5	0·25
Sulphur	S	0·11	S. & SO_2	0·12
Barium	Ba	0·09	BaO	0·10
Manganese	Mn	0·08	MnO	0·09
Other Elements		0·53	Others	0·21
Total		100·00		100·00

16. Composition of Minerals.—All of the elements mentioned above enter into the composition of minerals, but very few (e.g. oxygen, carbon, and iron) actually exist in the elementary state. In the great majority of minerals the elements are combined. Some mineral molecules are simple combinations of two elements, such as oxides, sulphides, and chlorides. Still more frequently the oxides of the elements enter into combination as salts. The non-metallic oxides form the anhydrides of acids, and these unite with the metallic oxides. Thus if the acidic oxide is carbon dioxide, CO_2, the mineral in which it occurs is called a carbonate. Similarly, sulphur trioxide, SO_3, forms sulphates; and, most important of all, silicon oxide, or silica, SiO_2, forms the vast group of minerals known as silicates. On these grounds minerals may be classified in a number of groups, of which the following are the chief :—

I.—Native Elements		
e.g. Diamond and Graphite		(Forms of Carbon)
II.—Oxides		
e.g. Quartz	..	SiO_2
Hæmatite	..	Fe_2O_3
III.—Haloids*		
e.g. Rock Salt	..	NaCl
Fluor Spar	..	CaF_2
IV.—Sulphides, Arsenides, etc.		
e.g. Pyrite	..	FeS_2
Mispickel	..	FeAsS
Smaltite	..	$CoAs_2$
V.—Carbonates		
e.g. Calcite	..	$CaCO_3$
Chalybite	..	$FeCO_3$
VI.—Sulphates		
e.g. Barytes	..	$BaSO_4$
Anglesite	..	$PbSO_4$
VII.—Phosphates and Arsenates		
e.g. Apatite	..	$Ca_4(CaF)(PO_4)_3$
VIII.—Borates and Nitrates		
e.g. Borax	..	$Na_2B_4O_7.10H_2O$
Nitre	..	KNO_3
IX.—Silicates		
e.g. Orthoclase	..	$KAlSi_3O_8$
Olivine	..	$(MgFe)SiO_4$
Muscovite	..	$H_2KAl_3(SiO_4)_3$
Zircon	..	$ZrSiO_4$

Some of the minerals which fall, for convenience, under the above headings contain water, which may be combined with the other constituents in various ways. Water which can be driven from a mineral at comparatively low temperatures is termed water of crystallisation. Thus gypsum, $CaSO_4.2H_2O$, contains two molecules of water of crystallisation, one of which is driven off at 120° C., the other at 200° C. The looseness of combination is indicated in the formula by expressing such water separately as H_2O. On the other hand, water may be bound up with the mineral molecule in so intimate a way that it can only be liberated by applying a high temperature. It is then called water of constitution, and in the formula for the mineral it is incorporated with the other elements and not written separately. Thus malachite, an important mineral consisting of copper

*The Haloid Elements are Fluorine, Chlorine, Bromine and Iodine.

carbonate and copper combined with water of constitution, is regarded as having the composition expressed by the formula $CuCO_3.Cu(OH)_2$, or $(CuOH)_2CO_3$.

The formula for a mineral is obtained from (*a*) the results of a chemical analysis and (*b*) the molecular weights of its constituents. The percentage of each oxide or other constituent is divided by its molecular weight, and the numbers so obtained are proportional to the numbers of the molecules of each oxide in the mineral. Thus, in the case of gypsum the process is as follows :—

Constituent	*Composition*	*Molecular Wt.*
CaO	32·5 %	56·1
SO_3	46·6 %	80·6
H_2O	20·9 %	18·0

The number of molecules of

$$CaO \propto \frac{32{\cdot}5}{56{\cdot}1} = 0{\cdot}579$$

The number of molecules of

$$SO_3 \propto \frac{46{\cdot}6}{80{\cdot}6} = 0{\cdot}577$$

The number of molecules of

$$H_2O \propto \frac{20{\cdot}9}{18{\cdot}0} = 1{\cdot}15$$

Now, since 0·579 : 0·577 : 1·15 = 1 : 1 : 2, we may express the composition simply as $CaO.SO_3.2H_2O$, or better as $CaSO_4.2H_2O$.

17. Polymorphism.—The form in which a mineral crystallises is largely dependent upon the conditions which govern its growth. Crystals may form at high temperatures in a molten rock magma, or at low temperatures from a mineral spring. They may form rapidly during a volcanic eruption, or with extreme slowness. They may be subject to high or low pressures. Under any set of conditions a substance will crystallise in the form then most stable. For this reason it is not very remarkable that many compounds can crystallise in two or more distinct forms. Calcium carbonate, $CaCO_3$, is a dimorphous substance, occurring as the two minerals—

Calcite, hexagonal ;
Aragonite, orthorhombic.

Carbon, a dimorphous element, occurs as—
Diamond, cubic ;
Graphite, hexagonal.

Iron disulphide, FeS_2, occurs as—
Pyrite, cubic ;
Marcasite, orthorhombic.

Titanium dioxide, TiO_2, is a trimorphous compound, existing as—
Anatase, tetragonal ;
Rutile, tetragonal ;
Brookite, orthorhombic.

18. Isomorphism.—In seeking for natural relationships among minerals, whereby they may be classified, none is of greater importance than the fact that substances which are of similar chemical composition often have nearly the same crystalline form.

Thus, the rhombohedral carbonates—

Calcite ..	$CaCO_3$ ..	74° 55′
Magnesite ..	$MgCO_3$ ..	72° 36′
Chalybite ..	$FeCO_3$ ..	73° 0′
Calamine ..	$ZnCO_3$ ..	72° 20′
Rhodocrosite	$MnCO_3$ ..	72° 58′

all have a similar molecular structure, all crystallise in the same class of the hexagonal system, and all cleave in rhombohedra, the angles of which, as shown above, are nearly alike. A group of substances of this kind, any member of which can replace any other in the crystal structure, is said to be *isomorphous*. The angles of the crystals built by the various members are not exactly equal (except in the cubic system, where there is no alternative), as was originally thought, and as is suggested by the term "isomorphous."

They are, however, nearly of the same value. Isomorphous substances are made up of molecules so nearly alike, that a growing crystal is indifferent to which of them it chooses to build up its structure, just as a colour-blind man might build a house of green and red bricks. Thus isomorphous molecules can replace one another without greatly altering the crystal form.

Other important examples of isomorphism are—

The Orthorhombic Sulphates :

Barytes	$BaSO_4$
Celestine	$SrSO_4$
Anglesite	$PbSO_4$

The Orthorhombic Carbonates :

Aragonite	$CaCO_3$
Strontianite	$SrCO_3$
Witherite	$BaCO_3$
Cerussite	$PbCO_3$

19. Pseudomorphs.—It sometimes happens that a well-crystallised mineral is replaced, volume for volume, by some other substance so that the crystal shape is still retained. A crystal having the form of one mineral and the composition of another, owing to replacement, is called a *pseudomorph*.

Thus, quartz may have the form of calcite, orthoclase may be replaced by cassiterite (tinstone), galena may take the place of pyromorphite, chalcedony sometimes replaces fluor spar, and limonite frequently occurs as a pseudomorph of iron pyrites,

magnetite, and chalybite. The replacement of wood by opal, forming "wood opal," in which all the fibrous structure is preserved, is an example of an analogous process.

20. Habit of Crystals.—According to the conditions under which crystallisation takes place, a crystal may assume a certain characteristic shape owing to more rapid growth in one direction than another. Thus, although it retains the forms and angles appropriate to it, certain faces may be more strongly developed than others. The shape so produced is called the *habit* of the crystal. Being dependent on the conditions of growth, habit is a variable character. Orthoclase, for example, may assume either of the two habits shown here.

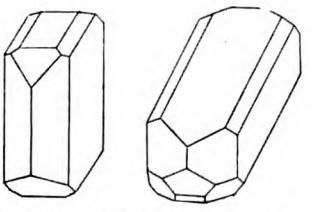
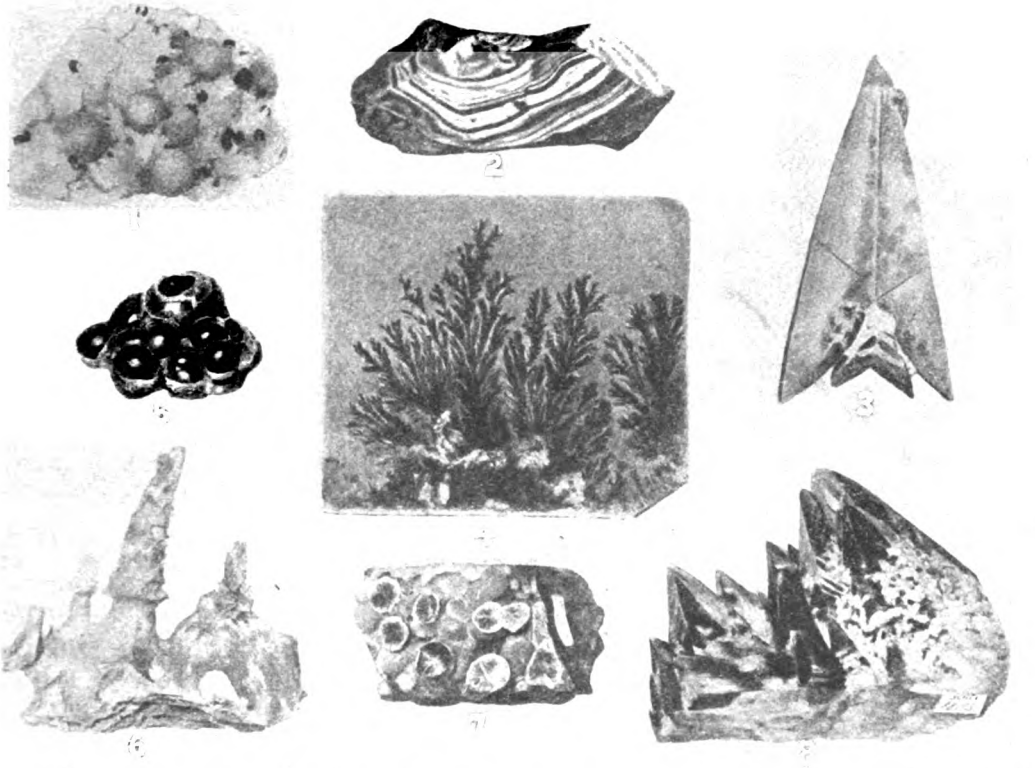


Fig. 47.—Habits of Orthoclase.

The following terms are employed:

Tabular, when one pair of parallel faces predominates, so that the mineral crystallises in "plates," e.g. barytes, hæmatite (specular iron).

Prismatic, when the crystal is elongated along one axis, and is said to crystallise in "prisms"; e.g. tourmaline, quartz, epidote.



TYPES OF MINERAL STRUCTURE.

1. Calcite (from Mexico) an example of globular structure; 2. Jasper, an example of banded structure; 3. Gypsum, an example of twinned crystal; 4. Pyrolusite (Manganese oxide), an example of dendritic structure; 5. Malachite, an example of nodular structure; 6. Calcite (from Derbyshire), an example of stalactitic structure; 7. Wavellite, an example of radiating, spherulitic structure; 8. Calcite (from Derbyshire), crystallised as scalenohedra (dog-tooth spar).

Acicular, when the prismatic habit is so marked that the mineral may be said to crystallise in "needles"; e.g. rutile, cerussite.

Capillary, when the crystals are so fine as to appear like threads or hairs; e.g. millerite.

21. Form of Crystal Aggregates.—The majority of crystals occur in groups, and the various modes of aggregation may be described as follows:

Parallel growth: In this case all the axes of one crystal are parallel to the corresponding axes of the other crystals, so that the crystals are completely parallel; e.g. certain groups of quartz crystals.

Drusy faces: The faces of some crystals are covered with a large number of minute crystals in parallel growth.

Geodes: Crystals sometimes line a cavity, which is then called a geode. If the crystals are very minute, the cavity may be said to be "drusy." The "potato-stones" of Bristol, which are hollow brown nodules lined inside with quartz crystals, afford good examples of geodes.

Amygdales: The vesicles and steam holes of volcanic rocks are often almond-shaped, and the minerals filling them are, therefore, known as *amygdales.* The structure is said to be *amygdaloidal;* e.g. zeolites, calcite, agate, &c., in basalts.

Stalactites: When mineral deposits are formed by the evaporation of solutions dripping from the roofs of caves, etc., they assume long slender cylindrical forms, of which icicles (formed by freezing instead of evaporation) are the best known example; e.g. calcite in limestone caves.

Stalagmites are generally associated with stalactites, being the corresponding deposits which form on the floors of caves under the drip from the stalactites above.

Photo: Underwood and Underwood.

STALACTITES AND ICICLES

are mineral deposits formed by the evaporation of solutions dripping from the roofs of caves, etc. Icicles (formed by freezing) are familiar structures of analogous type. The icicles shown above were photographed in the Great St. Bernard valley, Switzerland.

Nodules: Rounded or irregular concretions of minerals. When the nodules are nearly spherical they are said to be *globular;* e.g. marcasite balls in chalk or clay. When a rock is made up of large numbers of small round pea-like masses, it is said to be *pisolitic;* if the spherules are smaller still, like the roe of a fish, they are called *oöliths* and the rock is *oölitic.*

The important building stones of the Jurassic system: Portland stone, Bath stone, &c., are largely composed of oöliths.

The following adjectives are used for descriptive purposes:

Dendritic, when the crystals form fern-like masses; e.g. frost figures on windows, pyrolusite in cracks in sandstone. When the sprays are smaller, the form is said to be *mossy.*

Coralloidal, resembling coral, like some of the crystalline concretions of the Magnesium Limestone of Durham.

Botryoidal, when the crystals are in rounded masses like a bunch of grapes, or have an irregularly rounded surface; e.g. dolomite, hæmatite.

Other terms, like radiating, rosette shaped, wiry, leafy, require no special explanation.

22. Structure of Crystal Aggregates.—The internal structure of the above forms of crystal aggregation are described in the following terms:

Lamellar (foliated, micaceous), when the individual crystals are flattened and parallel; e.g. talc, muscovite, biotite, chlorite.

Columnar, when the crystals are prismatic and parallel; e.g. aragonite.

Fibrous, when the crystals are acicular or capillary; e.g. asbestos, gypsum.

Radiating, a fibrous structure in which the individual crystals diverge from a common centre, e.g. chalcedony, wavellite.

Granular, when the crystals are in equal-sized grains, as in loaf-sugar.

Massive or *compact,* a granular structure in which the grains are invisible to the naked eye.

Powdery, a granular structure in which the grains easily break apart.

23. Fracture.—When a mineral is broken with a hammer or a chisel it either splits and cleaves in a smooth plane or else it breaks irregularly.

The property of separating along certain planes is called *cleavage* and is intimately related to the crystalline structure of the mineral which exhibits it.

The *fracture* of a mineral is the nature of the irregularly broken surface. This is not a property which is capable of exact measurement, and in place of a more precise statement a comparative descriptive term must be used. Fracture is, therefore, described as:

(*a*) *Hackly*, when it is jagged and rough; e.g. copper.

(*b*) *Splintery*, when it is fibrous; e.g. steatite.

(*c*) *Conchoidal*, when it is curved like a shell; e.g. quartz and flint.

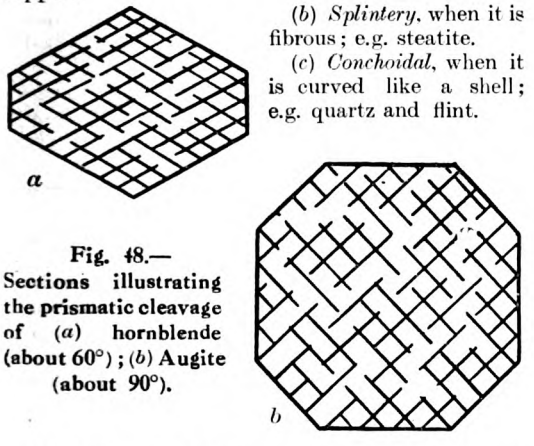


Fig. 48.—Sections illustrating the prismatic cleavage of (*a*) hornblende (about 60°); (*b*) Augite (about 90°).

(*d*) *Sub-conchoidal*, when the curves are not well defined; e.g. hæmatite.

(*e*) *Even*, when the broken surface is smooth; e.g. chalcedony.

(*f*) *Uneven*, when the broken surface is rough; e.g. tourmaline.

24. Cleavage.—When a crystal breaks by separating along smooth plane surfaces it is found that the latter are parallel to possible faces of the crystal, and the cleavage is named after the form in which these faces occur.

Sometimes, as in mica, it may happen that the cleavage is so perfect that very thin sheets may be obtained by continued splitting. It is to this property and the transparency of some varieties of mica (muscovite) that is due its use in chimneys, stove windows, gas burners, peep-holes of furnaces, etc. At one time window panes were made from it. But its use is reserved mainly for electrical purposes as an insulator.

Cleavage faces which are parallel to the same crystal form are all obtainable with equal ease, and have the same lustre and properties. Thus diamond, which crystallises in octahedra, also cleaves parallel to each of the eight octahedral faces.

Galena and rock salt cleave into cubes, fluor spar into octahedra, zinc blende into rhombdodecahedra, and calcite into rhombohedra.

Cleavage is described as *perfect*, as in the cases just cited, where it is easy to obtain; *good*, as in the prismatic cleavage of hornblende and augite; and *imperfect*, as in the basal cleavage of beryl or apatite. Sometimes, as in quartz and tourmaline, cleavage is very rarely obtained, and this

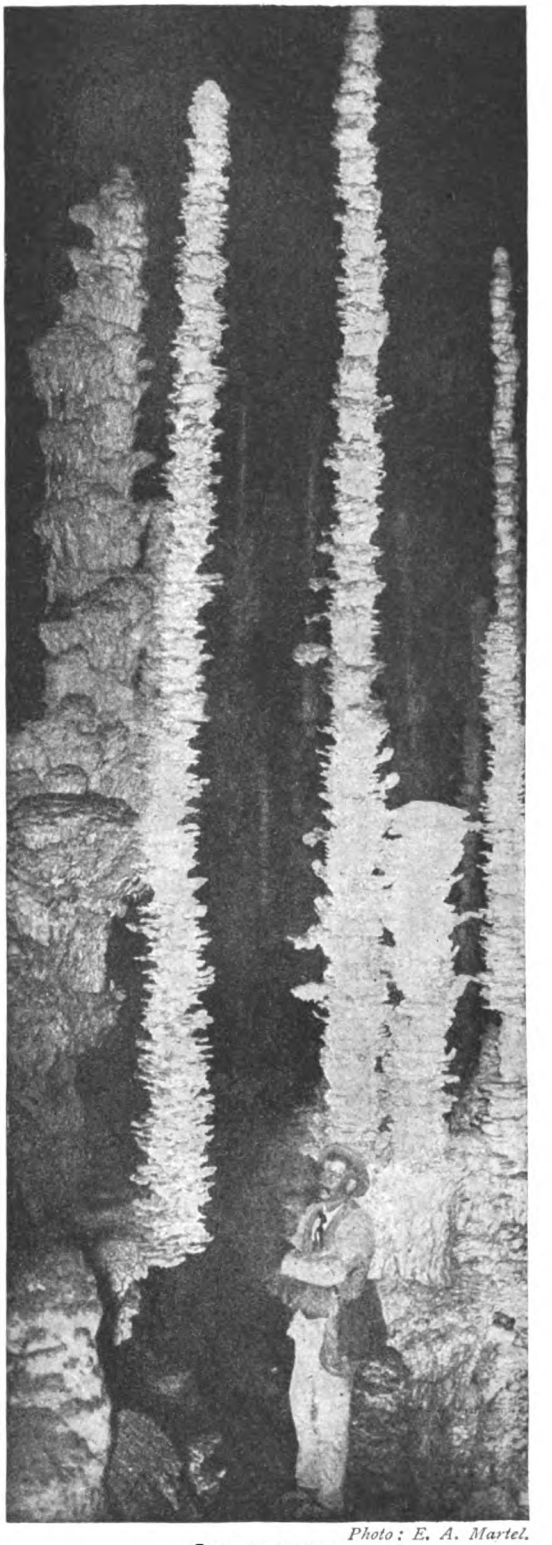


Photo: E. A. Martel.

STALAGMITES.

A striking example: Some of the crystalline columns of the Aren Armand, in France.

itself may be a fact of importance in distinguishing minerals.

25. Hardness.—Hardness is a term which is applied to that property of a mineral by which it resists scratching. If the sharp edge of one mineral scratches the smooth surface of another, the former is said to be the harder. A standard scale of hardness was devised by Mohs as follows:

10. Diamond.	5. Apatite.
9. Corundum.	4. Fluor.
8. Topaz.	3. Calcite.
7. Quartz.	2. Gypsum.
6. Orthoclase.	1. Talc.

Each mineral scratches all those below it, but is itself scratched by those above it. Thus, the hardness of a mineral is estimated by testing its capability for scratching the minerals in Mohs's scale. If it will scratch apatite but not orthoclase, its hardness lies between 5 and 6. It is useful also to remember that minerals may be scratched:

(*a*) by the finger-nail up to $2\frac{1}{2}$

(*b*) by a copper coin up to 4

(*c*) by a brass nail up to 3

(*d*) by a knife blade up to $5\frac{1}{2}$

The value of this character in determining minerals may be seen from the case of copper pyrites ($H = 3\frac{1}{2}$–4) and iron pyrites ($H = 6$–$6\frac{1}{2}$). Although these may closely resemble each other, the former is readily scratched by a knife blade, while the latter successfully resists.

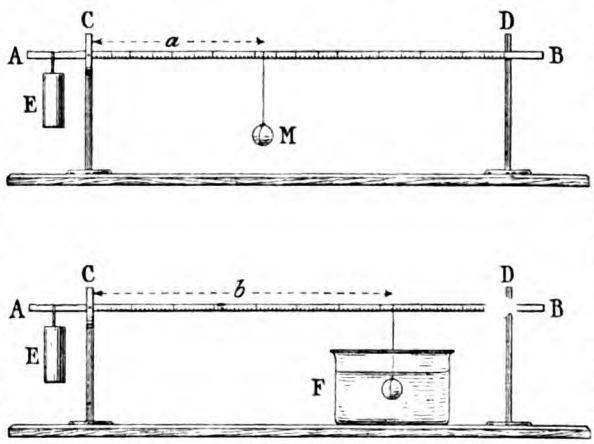


Fig. 49.—Illustrating the action of Walker's steelyard balance.

26. Lustre.—The intensity and nature of the light reflected from the surface of a mineral gives rise to a characteristic appearance to which the term *lustre* is applied. The following terms are used to describe the various kinds of lustre:

Metallic, like the surface of polished metals; confined to opaque minerals; e.g. galena.

Adamantine, shining and brilliant, almost like *metallic*, but confined to minerals which are at least partly transparent; e.g. diamond, cerussite.

Resinous, like the surface of broken resin—greasy-looking; e.g. pyromorphite.

Vitreous, like the surface of broken glass; e.g. quartz.

Waxy, like the surface of wax; e.g. chalcedony.

Pearly, like mother-of-pearl; e.g. talc.

Silky, like silk or satin—characteristic of fibrous minerals; e.g. gypsum.

Dull, when the light is diffused; e.g. kaolinite.

27. Colour and Streak.—The colours of minerals are of two kinds—*natural*, when dependent solely upon the chemical composition of the mineral, and *exotic*, when dependent upon traces of some intensely coloured impurity which acts as a pigment. Chromium and nickel are responsible for green colours, iron for red and brown, cobalt for blue, and manganese for pink and amethyst.

These colours are *natural* when the minerals are compounds of the metals in question, but *exotic* if they are merely tints in otherwise colourless minerals.

Quartz, which is naturally transparent and colourless, may be green, owing to traces of copper or nickel; amethyst, due to manganese; and rose-coloured, due to titanium. In such cases the colour is exotic, and if the quartz were powdered the effect of thickness would be overcome, and the powder would appear as white as if the quartz had been originally colourless. In this way accidental variations of colour may be avoided, and the principle is actively employed in determining minerals.

Colour becomes a character of some value if the mineral is powdered. The most convenient way to do this is to rub a corner of the specimen firmly over a piece of unglazed porcelain. A mark, called the *streak*, is thus made, the colour of which is that of the powdered mineral, and often, it must be noticed, the colour is very different from that of the massive mineral. As the streak of a mineral is a factor of considerable importance, the following examples have been compiled:

White: Borax, gypsum, talc, kaolin, calcite, dolomite, felspars, mica, quartz, garnet, etc.

Yellow or *orange:* Orpiment, realgar, pyromorphite, zinc blende, limonite.

Red or *brown:* Cinnabar, zinc blende, hæmatite, cassiterite, cuprite.

Green: Malachite, garnierite, chrysocolla.

Blue: Azurite, vivianite.

Other optical effects which deserve to be mentioned are the following, some of which are due to cracks and flaws and the interference of internally reflected light, others to a finely lamellar structure or the presence of other minerals:

Play of colours: Irregular flashing of colours, as in precious opal.

Change of colours: Different colours seen in different directions, as in labradorite.

Iridescence: Bands of colour due to fine cracks, often between cleavage surfaces, as in gypsum and mica.

Opalescence: A milky appearance seen in some translucent minerals, such as common opal and moonstone.

Tarnish: A superficial iridescence due to chemical change at the surface of a mineral. Copper pyrites

is frequently beautifully tarnished, and is then appropriately known as "peacock copper."

28. Specific Gravity.—The specific gravity of a substance is the ratio of the weight of any volume of the substance to the weight of an equal volume of water. Now, when a substance is immersed in water, the apparent loss of weight is equal to the weight of the water displaced—that is, to the weight of a volume of water equal to the volume of the substance. Hence, if a piece of a mineral is weighed in air, and then immersed in water and weighed again, the specific gravity is easily calculated.

Let W be the weight in air,
and w „ „ „ „ water.

Then W − w = the weight of a volume of water equal to that of the mineral.

$$\text{Hence the specific gravity (Sp. Gr.)} = \frac{W}{W-w}$$

This simple experiment may easily be done with an ordinary chemical balance. A number of special forms of apparatus have been devised for rapidly determining the specific gravities of minerals. Perhaps the simplest of these is that known as Walker's steelyard balance, which gives quick and reliable results while obviating the necessity of a set of weights. As will be seen from the diagram, it consists of a beam A B with the fulcrum placed at C, so that there is a long arm C B (which is graduated) and a short arm C A. A constant weight E is suspended from the notched edge of the short arm. The mineral M is suspended from a fine thread and moved along the beam until it counterbalances the constant weight. The position of balance is known from a mark on the stand D, so placed that when the upper edge of the beam just reaches it the beam is horizontal. Equilibrium having been attained, the position of the suspending thread on the beam is read off, the reading giving the distance a from the fulcrum at C. The specimen is then immersed in water and moved farther along the beam until balance is restored, the constant weight E being left in the same position as before. A second reading giving the distance b is then taken.

Using the letters W and w as above, and representing by X the moment of the weight E about the fulcrum C, we have:

$$X = Wa = wb$$

$$\therefore W = \frac{X}{a} \text{ and } w = \frac{X}{b}$$

$$\text{whence, } W - w = X\left(\frac{1}{a} - \frac{1}{b}\right) = X\frac{(b-a)}{ab}$$

$$\therefore \text{Sp. Gr.} = \frac{W}{W-w} = \frac{b}{b-a}$$

Thus, the two readings now taken suffice to give the required specific gravity. It is important to take precautions against adherent air bubbles, which would obviously vitiate the result when weighing in water. This may be done by thoroughly wetting the specimen under a tap—using a brush if necessary—before proceeding to make the second measurement. A. H.

ZOOLOGY.—XXIV

ALTHOUGH a number of marine fishes have been mentioned amongst the sub-orders already dealt with, the majority of the sea fish are classed amongst the *Acanthopterygii* or Spiny-Finned Fishes. In this sub-order, the flat fishes excepted, "the foremost rays of the dorsal and anal fins are spinous and hard, instead of being jointed and flexible or soft." The gill opening is usually large and is placed in front of the pectoral fin.

The Perches, Mackerels and Flat fishes are all useful members of this sub-order.

The Perch, well known to the British angler, is found in our rivers and lakes where in normal circumstances he attains a weight of from one to three pounds. He is a handsome and well-proportioned fish, and offers good sport to the fisherman.

Another fresh-water fish which closely resembles the Perch is the Pope or Ruffe.

The Bass is a marine Perch which, however, is taken in the estuaries of rivers in the autumn when it enters them to spawn. The voracious habits of this fish earned for it the name of wolf, and it is still occasionally referred to under the generic title *Labrax lupus*.

The Tile-Fish is taken off the American shores of the North Atlantic. It is a brightly coloured fish and makes a welcome table dish.

Mullet and other *Mullidæ*

The Red Mullet is a European representative of the *Mullidæ*, which are mostly tropical fishes, and is greatly prized for its delicate flavour. The length of the Red Mullet rarely exceeds one and a half feet. It is taken off Cornwall, but in greater numbers in the Mediterranean.

A very curious fresh water fish included in this sub-order goes by the name of the Archer Fish, which catches the insects upon which it feeds by the highly ingenious method of squirting a jet of water at them from its mouth. Its aim is phenomenally accurate, and rarely fails to tumble the astonished quarry from the leaf upon which it is resting into the water where the Archer awaits its appearance.

The Archer is a native of the East Indies and New Zealand and, as is not altogether surprising, is frequently kept by the Malays as a source of amusement. Had the gift of a fleeting smile been granted to the fish, it is not a very daring speculation that the Archer after a more than usually successful

shot would permit himself the satisfaction of indulging in one.

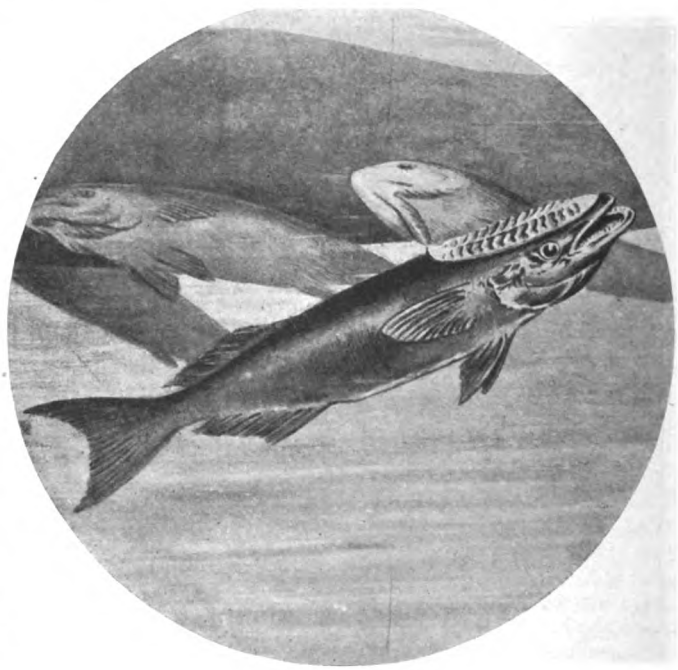
An idiosyncrasy of a less useful description is that possessed by the Fighting Fish of Siam. In this case a small fish of dull colour and respectable appearance becomes entirely transformed by the presence in his waters of another of his own species. Instantly his body assumes a dazzling hue his throat becomes distended, and he hurls himself at the visitor. This well-known peculiarity has led the Siamese to keep this fish for fighting purposes in much the same fashion as the Spaniards preserve the Fighting Cock.

The Angel Fishes of the species *Holacanthus* are brightly coloured and of a highly edible nature. The Surgeon Fishes of the genus *Acanthurus* are so called by reason of the lancet-like spines attached to the tail.

Those very dissimilarfishes the Mackerel and the Swordfish are both included in the category of *Scombriformes*, and are allied by close bonds to the Perches. Swift in movement and possessed of great powers of endurance these fish are to be found throughout the tropical and temperate zones.

The Mackerel commence to move in great shoals into the English Channel from the Atlantic in January; later in the year, about August, they reach the northernmost parts of Great Britain. The average weight of the Mackerel is probably about two pounds, though these fish show considerable variation in size. This fish is exceedingly voracious and feeds upon the fry of other fishes; its approach to the British coasts is, in fact, usually undertaken in pursuit of young Pilchards and Sprats. The Spanish Mackerel occurs in the Mediterranean and in the Atlantic, and is occasionally taken off the Cornish coast. Its head is larger than that of the common Mackerel and its sides are spotted.

The Tunny, a giant relative of the Mackerel, is found on both sides of the Atlantic and in the Mediterranean. A length of ten feet and a weight of 1,000 lb. is not exceptional for this monster. The Bonito is sometimes termed the "sailor's friend" from the fact that large schools of them will occasionally accompany a slow-moving ship for several days on end.

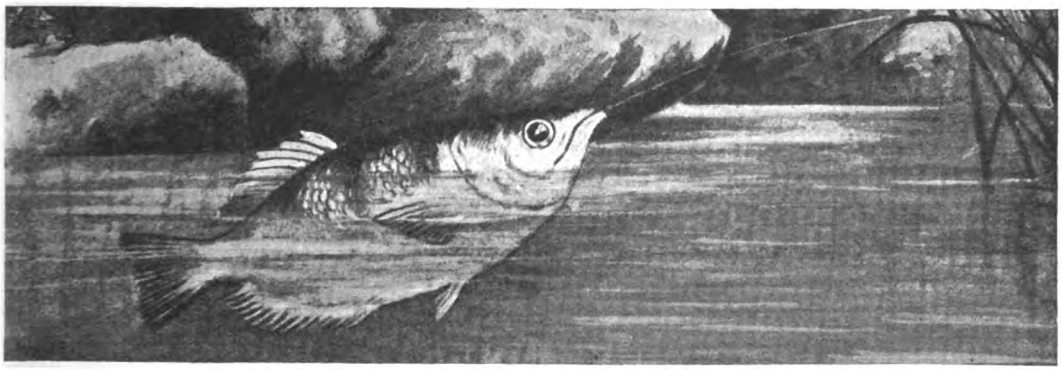


SUCKING FISHES

have the anterior dorsal fin on the top of the head, and so modified as to form a sucker by means of which they attach themselves to large fishes and even ships.

The Sword Fish whether of the genus *Xiphias*, which includes the Common Sword Fish, or of the genus *Histiophorus*, which includes the Sword fishes of the Indian and Pacific Oceans, attains to a considerable length, sometimes as great as fifteen feet. A more usual length for the Common Sword Fish is ten feet, in which case the sword in front of the orbit of the eye measures three feet five inches. The upper jaw, which constitutes the sword, is more or less flat, and extends far in advance of the lower jaw. The high dorsal fin carried by some species of the *Histiophoridæ* has earned for them the title "Sail Fish." The *Histiophorus gladius* is a case in point. As a weapon of defence the sword is deadly in the extreme. The weight of the fish backed by the velocity at which it swims is quite capable of driving this weapon through the stout oaken timbers of a ship.

The *Echeneiformes* or Sucking Fishes are a remarkable species in which the anterior dorsal fin is placed upon the top of the head, and so modified as to form a sucker. With



ARCHER FISH.

A curious fresh water native of New Zealand and the East Indies; it catches the insects upon which it feeds by the ingenious method of squirting a jet of water at them from its mouth.

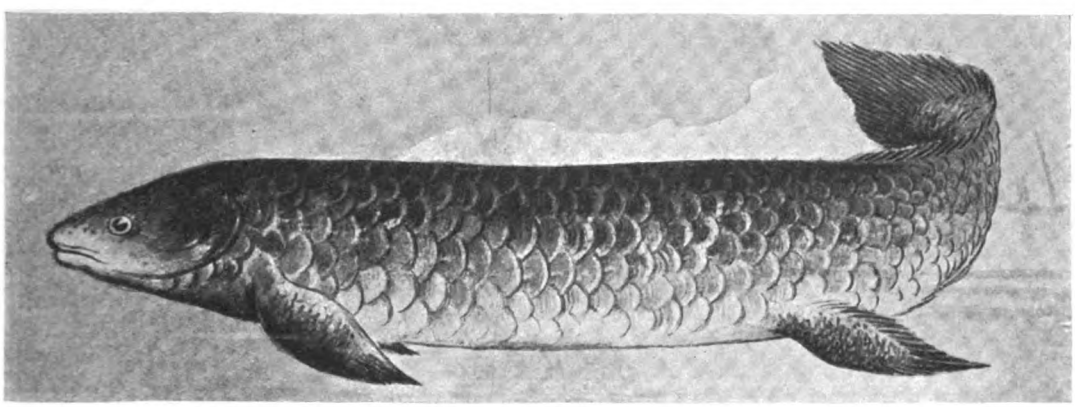
this implement the sucker attaches itself to sharks, whales and other large fishes, and even to the hulls of vessels and so transports itself from one part of the ocean to another.

Extraordinary legends in past days built themselves up around the peculiarity of this small fish, for the hardy mariners who returned from voyages could in these happy times recount experiences which no one at home had the knowledge to refute. That a Sucking Fish thought nothing of arresting a large ship in its course and of dragging it beneath the waves was comparatively a mild statement. But the Sucker, though little larger than a Herring, is certainly remarkable in the strength of his attachment; from that which he hath joined he is hard to pull asunder.

The Pilot Fish owes its chief claim to fame to the peculiar intimacy which is known to exist between this species and the Shark. Many travellers tell us that he warns his great companion of danger, and guides it to its food. But scientists deem it more probable that the Pilot follows the Shark in order to feed upon the parasites with which that monster is infested.

The family *Pleuronectidæ*, which is one of two divisions into which the *Zeorhombiformes* or Flat Fish have been divided, includes those fish, such as the Plaice and the Flounder, which are most usually associated with the expression Flat Fish.

As everybody is aware, the chief characteristics of the Flat Fish are that it rests upon its side, and that one eye as a consequence of this habit is placed high upon the forehead. But what is possibly more interesting than this anatomical feature is the fact that the Flat Fish when hatched from the egg is entirely symmetrical. At this moment it swims in a vertical position, carries its eyes one upon each side of the



LUNG FISH,

a denizen of Australian rivers, instead of having an air-bladder, possesses the lungs of a true land vertebrate.

head, and resembles in its general appearance any other fish of normal build. But later there comes a remarkable change, for the Flat Fish from sheer inability to balance itself turns upon its side. But, inasmuch as the same accident has happened to the Flat Fish for countless years in the past, Nature is entirely prepared to cope with it, and within a short space of time what was once the side but is now the upper part of the body has assumed colours that harmonise with the fish's new surroundings.

Plaice and Sole

The Plaice is found in great numbers in British waters and in northern waters generally. The Flounder, though actually a sea fish, frequently ascends rivers for some distance above the flow of the tide, and is taken in numbers in the estuaries of some rivers. It abounds on all the British coasts, and extends from France round the northern shores of Europe to Iceland and Greenland.

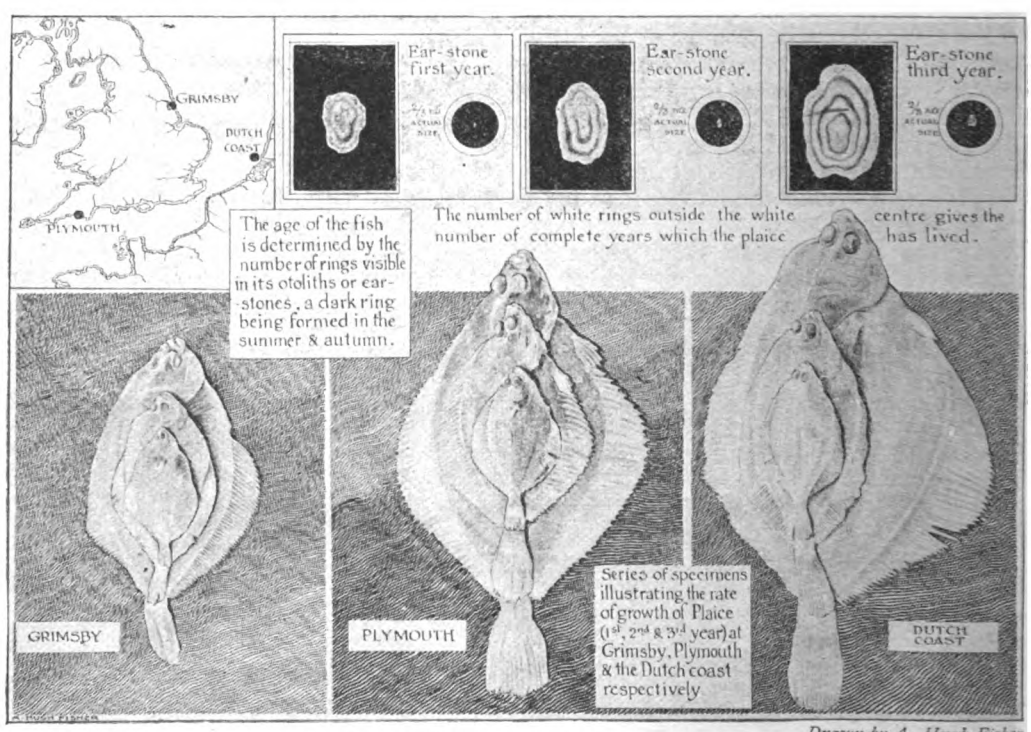
The Common Sole frequents deeper and warmer water than the Flounder. It is abundant round the coasts of England and Ireland, along the western coast of Europe and in the Mediterranean. The average weight of this fish is about one pound, though much larger specimens have been recorded. The Sand Sole is often called the Lemon Sole, but as often as not it is the Smear Dab which passes for the Lemon Sole in the store of the fishmonger.

The Halibut, the largest of the Flat Fishes, inhabits the deeper waters which fringe the southern shores of the Arctic. The average length of this fish is between four and five feet. The Turbot is the most valuable of all the Flat Fish and commonly weighs from five to ten pounds.

The John Dory

The family *Zeidæ* includes the John Dory, a fish of odd appearance that frequents the warmer waters from Madeira to Norway. The body of this fish is deep and flattened and is held, when the fish is swimming, but slightly out of the vertical.

The Lung Fishes, or *Dipnoi*, are remarkable for a complete transformation of the air-bladder into lungs which occupy precisely the same position in the fish as do the lungs in a true land vertebrate. Lung Fishes, geologically of great antiquity, are denizens of Australian rivers. A. B.



HOW TO TELL THE AGE OF A PLAICE.

The fish shown above serve to illustrate the average annual growth of the species about Grimsby, in the English Channel near Plymouth, and on the Dutch coast. Another way of determining the fish's age by means of the otoliths or ear-stones is also shown.

Continued from page 222.

LANGUAGES:

Contributors:—LATIN, GREEK and FRENCH (E. A. Baker, M.A., D.Lit.). GERMAN (M. A. Lewenz, M.A. [Lond.]). SPANISH, RUSSIAN and ITALIAN (Alfred Calvert, First Prizeman in Modern Languages, R.S.A., London).

GERMAN.—XXVI

The Infinitive is, properly speaking, a verbal noun, that is, a word which has the properties of a noun and of a verb. As a noun it may be the subject, object, or complement of a verb, or it may be governed by a preposition; as such, too, it may be qualified by a definite article or an adjective. As a verb it may govern a case and be modified by an adverb.

When used as an ordinary noun it is always a strong noun of neuter gender, Class I.; since Infinitives used in this way are mostly abstract nouns, they do not, as a rule, have a plural. In such cases the Infinitive is, of course, written with a capital. Thus, das helle Lachen des Kindes machte ihm Freude, *the bright laughter of the child gave him pleasure;* here Lachen is the subject of machte and is qualified by hell.

In the following example it exhibits the properties of a noun and a verb: er wollte ſchnell etwas ſagen, *he wanted to say something quickly;* the Infinitive ſagen is the object of the verb wollte, at the same time it governs etwas in the accusative case, and is modified by the adverb ſchnell. In such cases the Infinitive is not written with a capital.

In many of its uses the Infinitive has the preposition zu closely attached to it.

The Infinitive as Subject of a Verb.—There are two cases with and without zu:—

I. Without zu. Irren iſt menſchlich, *to err is human;* fleißig arbeiten das iſt die Hauptſache, *to work diligently, that is the main thing;* alt werden, das iſt Gottes Gunſt, jung bleiben, das iſt Lebenskunſt, *to grow old is the gift* (favour) *of God, to remain young is the art of living.*

II. With zu. Es iſt unrecht zu ſtehlen, *it is wrong to steal;* ſeine Mitmenſchen zu lieben iſt eine Pflicht, *to love one's fellow creatures is a duty;* es iſt manchmal ſchwer recht zu tun, *it is sometimes difficult to do right.*

The Infinitive may be used with or without zu as the subject of a verb.

The Infinitive as Object of a Verb.—There are numerous cases:—

I. Infinitive without zu—

a. Dependent on the modal auxiliaries, können, mögen, etc. Thus, er wollte heute kommen, *he wanted to come to-day.*

b. Dependent on werden as an auxiliary for the future. Thus, es wird wohl regnen, *it will probably rain.*

c. Dependent on haben as an auxiliary for the perfect tenses, in those cases when the Infinitive form is used instead of the Past Participle. Thus, er hat nicht kommen können, *he has not been able to come.* Dependent on haben followed by certain adjectives. Thus, er hat gut reden, *it is all very well for him to talk.*

d. Dependent on tun in the rare cases in which it is used as an auxiliary like English *do.* Thus, und tu' nicht mehr in Worten kramen, *and do no longer traffic in words.*

e. Dependent on laſſen in a causative sense. Thus, ich ließ ſie nach Hauſe führen, *I caused her to be taken home;* er läßt ein Haus bauen, *he is having a house built.*

f. Dependent on lernen, to learn. Thus, ich habe ſingen gelernt, *I have learnt to sing.*

g. Dependent on verbs which take a double object (of which the Infinitive is one) such as lehren, *to teach,* nennen, *to call,* machen, *to make,* laſſen, *to let,* etc. Thus, was man ſo erkennen nennt, *what people call knowing;* ich ließ ihn gehen, *I let him go.*

h. Dependent on verbs denoting perception by the senses, such as ſehen, *to see,* hören, *to hear,* fühlen, *to feel,* finden, *to find,* and so on. Thus, ſie hat mich ſingen hören, *she heard me sing* (or singing); ich fühlte das Gewitter kommen, *I felt the storm coming.*

Sometimes the object of the principal verb is omitted, and then the Infinitive is used without reference to any special person or thing. Thus, ich höre ſprechen, *I*

hear (some one) speak (or, as we should say, *I hear voices*); er ließ überall ſuchen, *he caused (people) to look everywhere.*

If the Infinitive itself takes an object, the construction is equivalent to one in which the accusative is the object of the principal verb and the Infinitive, though active in form, is passive in meaning and qualifies the accusative. Thus, er ließ viele Häuſer bauen, *he had many houses built* (he caused many houses to be built); er hörte das Lied ſingen, *he heard the song sung;* er ließ ſich nicht beirren, *he did not let himself be misled.*

k. The Infinitive is used where we should use a Present in certain constructions with bleiben (*to stay*) and haben. Thus, er blieb ſtehen, *he remained standing.*

l. The Infinitive of purpose without zu is used in a few phrases. Thus, ich lege mich ſchlafen, *I lie down to sleep;* and similarly, ſchlafen gehen, *to go to bed;* betteln gehen, *to go begging;* ſpazieren gehen, fahren, reiten, führen, *to go for a walk, for a drive, for a ride, to take for a walk.*

II. The Infinitive with zu is used as a Direct Object—

a. With ordinary transitive verbs. Thus, ich liebe nicht zu warten, *I do not like to wait.*

The verbs which most frequently take an Infinitive with zu as their sole object are such as denote endeavour, beginning, desiring, refraining, promising, venturing.

b. With verbs which also take an indirect object. Thus, er verbot mir zu ſchweigen, *he forbade me to remain silent.* These are mostly verbs of commanding, forbidding.

III. The Infinitive with zu is dependent on another Verb in the following ways:

a. To express purpose. Thus, ich bin gekommen ihre Mutter zu beſuchen, *I have come to visit your mother.* The purpose may be emphasised by prefixing um to the Infinitive with zu. Thus, er ging nach Hauſe um ſeine Sachen zu holen, *he went home to fetch his things.*

b. In a passive sense dependent on ſein and ſtehen. Thus, da war ſo viel zu tun, *there was so much to do* (to be done).

c. With haben when it denotes obligation, necessity (English, *have to*). Thus, ich habe viele Briefe zu ſchreiben, *I have many letters to write.*

d. Taking the place of a remoter object or a prepositional phrase. Thus, es freut ihn das Bild zu beſitzen, *it pleases him to possess the picture.*

The Infinitive with zu depending on an Adjective. Such adjectives usually denote possibility, ease, difficulty, desire, necessity, and the like. Thus, das iſt leicht zu verſtehen, *that is easy to understand;* ich bin bereit alles zu tun, *I am ready to do everything.* Many adjectives when modified by zu, *too*, and genug, *enough*, can be followed by the Infinitive with zu. Thus, der Berg war zu ſteil zu erklimmen, *the mountain was too steep to climb.*

The Infinitive with zu depending on a Noun.

a. The noun is akin in meaning to the verbs and adjectives specified above which have an Infinitive depending on them. Thus er hat das Bedürfniß viel zu ſchlafen, *he feels* (has) *the need to sleep a lot.*

b. The zu before the Infinitive practically retains its original prepositional meaning and function and connects the Infinitive with the noun. Thus, er hatte nicht den Mut zu ſprechen, *he had not the courage to speak.*

c. The Infinitive is more or less equivalent to a qualifying genitive. Thus, die Zeit zu ſchweigen iſt vorüber, *the time of silence* (for being silent) *is over.*

VOCABULARY

wohlan, *well then, all right.*
wann, *when.*
weiterziehen, s., *to go on.*
allein (conjunction), *however.*
Geſundheit, w.f., *health.*
Krankheit, w.f., *illness.*
bös, *bad, evil.*
Freude, w.f., *pleasure, delight.*
ſich umſehen, s., *to look round.*
folgen, w., *to follow.*
wie, *what.*
ſchweigen, s., *to be silent.*
Fieber, s.n. I, *fever.*
niederwerfen, s., *to overthrow.*
betäuben, w., *to benumb, daze.*
Gicht, w.f., *gout.*
Ohr, s.n. (w. plur.), *ear.*
Zahn, s.m.2, *tooth.*
dunkel, *dark.*
Gewinn, s.m., *gain, advantage.*
ſicher, *safe.*
luſtig, *merry.*
Jugend, w.f., *youth.*
aushalten, s., *to last.*
Schmerz, w.m., *pain.*
vorüber, *over, past.*
Schulter, w.f., *shoulder.*
Abſchied, s.m.2, *farewell, departure.*
brechen, s., *to break.*
ſchicken, w., *to send.*
anſtoßen, s., *to strike.*
ſchwindel, s.m. I, *dizziness.*
zwicken, w., *to nip.*
brauſen, w., *to roar, buzz.*
nagen, w., *to gnaw.*
Backe, w.f., *cheek.*
leiblich, *very own.*
erinnern an, w., *to remind of.*
ſich ergeben, s., in, *to resign oneself to.*
Geſchick, s.n.2, *fate.*

Exercise 59

Die Boten des Todes (Fortſetzung)

„Wohlan," ſprach der Jüngling, „immer[1] ein Gewinn, daß ich weiß, wann du kommſt[2] und ſo lange wenigſtens ſicher vor dir bin," zog weiter, war luſtig und guter[3] Dinge und lebte in den Tag hinein. Allein Jugend und Geſundheit hielten nicht lange aus; es kamen Krankheiten und Schmerzen, die ihn plagten. „Sterben werde ich nicht," ſprach er zu ſich ſelbſt, „denn der Tod ſendet[4] erſt ſeine Boten; ich wollte nur, die böſen Tage der Krankheit wären erſt[5] vorüber." Sobald er ſich geſund fühlte, fing er wieder an in Freuden zu leben. Da klopfte ihm[6] eines[7] Tages Jemand auf die Schulter.

und als er sich umsah, stand der Tod hinter ihm und sprach: „Folge mir. Die Stunde des Abschieds von der Welt ist gekommen." — „Wie," rief der Mensch, „willst[9] du dein Wort brechen? Hast du mir nicht versprochen, daß du mir, bevor du selbst kämest[9], deine Boten senden wolltest[9]? Ich habe keinen gesehen." — „Schweig," erwiederte der Tod, „habe ich dir nicht einen[10] Boten über den andern geschickt? Kam nicht das Fieber, stieß dich an und warf dich nieder? Hat der Schwindel dir[11] nicht den Kopf betäubt? Zwickte dich nicht die Gicht in allen Gliedern? Brauste Dir's nicht in den Ohren? Nagte nicht der Zahnschmerz in deinen Backen? Ward's dir nicht dunkel vor den Augen? Über das Alles, hat nicht mein leiblicher Bruder, der Schlaf, dich jeden Abend an mich erinnert? Lagst du nicht in der Nacht, als wärst[12] du schon gestorben?" — Der Mensch wußte Nichts zu erwiedern, ergab sich in sein Geschick und ging mit dem Tode fort.

Grimm.

NOTES:—

(1) immer ein Gewinn—this is elliptical, and the words es ist must be supplied; immer is used in the sense of *at any rate*. (2) kommst, present in the sense of Future. (3) guter Dinge sein, *to be of good cheer*. (4) sendet—*see* (2). (5) erst—this is impossible to render in English; it emphasises the wish. (6) ihm, dative of the person, followed by the definite article where we use a possessive. (7) eines Tages, genitive used adverbially. (8) willst du, *are you going to*. (9) kämest, wolltest, Conjunctive of indirect statement. (10) einer über den andern, *one after another*. (11) dir—for this dative and the following ones, *see* (6). (12) wärst, Conjunctive after als introducing a hypothetical clause.

VOCABULARY

one by one, einer nach dem andern.
kill, tödten, w.
spear, Speer, s.m.2.
confusion, Verwirrung, w.f.
current, Strömung, w.f.
terrified, entsetzt.
look, hinblicken, w.
honour, Ehre, w.f.
for ever, auf immer.
cries, Geschrei, s.n.
plunge through, durchwaten, w. sep.
by this time, jetzt.
retreat, sich zurückziehen, s. sep.
enterprise, Unternehmen.
land, ans Land steigen, s.
thrust, Stoß, s.m.2.
stab, erstechen, s.
slay, erschlagen, s.
to be drowned, ertrinken, s.
draw back, zurückweichen, s. sep.
cry out, rufen, s.
lose, verlieren, s.
encourage each other, sich gegenseitig ermutigen, w.
assault, anfallen.
come to assistance, zur Hülfe kommen, s, gov. dat.
give up, aufgeben, s. sep.

Exercise 60 (*Continuation of* 58)

But as they could only pass the ford one by one, the[1] Bruce, who stood high above them on the bank where they were to land, killed the foremost man[2] with a thrust of his long spear, and with a second thrust stabbed the horse. In the confusion five or[3] six of the enemy were slain, or, having[4] been borne down by the current, were drowned. The rest were terrified[5] and drew back. But when the Galloway men looked again and saw that they[6] were opposed by only one man, they[7] themselves being so many, they cried out that their honour would be lost[8] for ever if they did not force[9] their way, and encouraged each other, with loud cries, to plunge through and assault him. But by this time the king's soldiers came up to his assistance, and the Galloway men retreated and gave up their enterprise. *Sir Walter Scott.*

NOTES:—

(1) Omit *the*. (2) Omit *man*. (3) Or, here bis. (4) Say, the rest drew back terrified, (5) Having been borne down, fortgerissen. (6) They . . . . man, say, that only one man stood opposite (gegenüber) to them. (7) They . . . many, während ihrer so viele waren, i.e. while of them there were so many. (8) To be lost, verloren gehen. (9) Force their way, den Übergang (crossing) erzwingen, i.e. to force the crossing.

Key to Exercise 57

THE MESSENGERS OF DEATH

In olden times a giant was once wandering on the great highroad, when suddenly an unknown man sprang towards him and cried, "Halt! not a step farther." "What!" said the giant. "You little wretch, whom I can crush between my fingers, you want to bar my way? Who are you, that you dare (may) speak so boldly?" "I am Death," replied the other. "No one can withstand me, and you too must obey my behests." But the giant refused, and began to wrestle with Death. It was a long and violent struggle, but at length the giant prevailed and felled Death with his fist, so that he collapsed next to a stone. The giant went his ways, and Death lay there vanquished, and, what is more (moreover), so powerless that he could not rise again. "What is to happen? (What is to become of it?)" said Death, "if I remain lying here in a corner? Nobody will die now (any more) on the earth, and it will grow so full of people that they will not have room to stand next one another." Meanwhile a young man came along the road; he was sturdy (fresh) and healthy, was singing a song, and glanced hither and thither. When he saw the half fainting man he approached him compassionately, raised him up, gave him a reviving draught from his flask and waited till he had regained his strength. "And do you know," asked the stranger, "who I am, and whom you have succoured?" "No," answered the youth, "I do not know you." "I am Death," said he, "and spare no one; I cannot make an exception in your case (with you) either. But so that you may see that I am grateful, I promise you that I will not attack you unawares, but will first send you my messengers, before I come and fetch you."

Key to Exercise 58

Er stand also und horchte; und bald nachher, als das Gebell des Hundes näher kam, fing er an das Getrabe von Pferden und die Stimmen von Menschen und das Geklirr und Gerassel von Waffen zu hören, und da ward es ihm zur Gewißheit, daß der Feind nach dem Ufer käme. Dann dachte der König, „Wenn ich zurückgehe, um meine Leute zu den Waffen zu rufen, werden diese Männer von Galloway ohne Widerstand durch die Furte gehen; und das wäre Schade, da es ein so günstiger Ort zur Verteidigung ist." Er schickte seine Begleiter seine Leute zu wecken und blieb allein auf dem Ufer zurück. Unterdessen nahmen der Lärm und das Getrabe von den Pferden zu, und da der Mond hell schien, erblickte Bruce die blitzenden Waffen von ungefähr zwei hundert Mann, die nach dem gegenüberliegenden Ufer herunterkamen. Die Männer von Galloway, ihrerseits, sahen nur eine einzige Gestalt, welche die Furte bewachte, und die Vordersten stürzten sich in den Fluß, ohne sich um ihn zu kümmern.

M. A. L.

RUSSIAN.—XV

The Participle

The Passive Participle

164. This is formed of the abbreviated Present and Past Participles (Passive Verbs), as given in Lesson XIV, by elongating them to the full adjectival endings.

Examples

Passive Participles Abbreviated Form (Predicative)	*Passive Participles Full Form (Attributive)*
Фабрику́емъ, *is being manufactured.*	Фабрику́емый *which is manufactured.*
Уважа́емъ, *is respected, esteemed.*	Уважа́емый, *which is respected.*
Про́данъ, *is sold.*	Про́данный, *which was sold.*
Ку́пленъ, *is bought.*	Ку́пленный, *which was bought.*

165. The "н" of the Passive Participle of the Past Tense is always doubled whenever a passive verb ending in -анъ or -енъ is elongated to a full adjectival ending.

166. Passive Participles are in every respect governed by the rules applying to Adjectives with regard to Gender, Number, and Declension.

The Active Participle, Present Tense

167. This is formed from the 3rd Person Plural, Present Tense, by rejecting the ending -тъ, and replacing it by -щій, -щая, щее, -щіе, щія, corresponding to the gender and number.

Examples

3rd Person Plural	*Active Participle, Present Tense*
Они́ покупа́ютъ, *they buy.*	Покупа́ющій, *he who buys.*
Они́ продаю́тъ, *they sell.*	Продаю́щій, *he who sells.*
Они́ и́мѣютъ, *they have.*	И́мѣющій, *he who has.*
Онѣ́ говоря́тъ, *they* (fem.) *speak.*	Говоря́щая, *she who speaks.*
Они́ пи́шутъ, *they write.*	Пи́шущій, *he who writes.*
Они́ иду́тъ, *they go.*	Иду́шій, *he who goes.*

The Active Participle, Past Tense

168. This is formed from the Past Singular by rejecting the ending -лъ, and adding -вшій.

Examples

Past Singular	*Active Participle, Past Tense*
Онъ покупа́лъ, *he bought.*	Покупа́вшій, *he who bought.*
Онъ купи́лъ, *he has bought.*	Купи́вшій, *he who has bought.*
Онъ продава́лъ, *he used to sell.*	Продава́вшій, *he who used to sell.*
Онъ про́далъ, *he has sold.*	Прода́вшій, *he who has sold.*

169. The following are a few exceptions to the preceding rule:

Past Singular	*Active Participle, Past Tense*
Онъ нёсъ, *he carried.*	Нёсшій, *he who carried.*
Онъ вёлъ, *he conducted.*	Ве́дшій, *he who conducted.*
Онъ шёлъ, *he went.*	Ше́дшій, *he who went.*
Онъ привлёкъ, *he has attracted.*	Привлёкшій, *he who has attracted.*
Онъ у́меръ, *he died.*	У́мершій, *the deceased.*

170. The Active Participles are subject to the same rules as Adjectives with regard to Gender, Number, and Declension.

The Gerund

The Gerund, Present Tense, Active

171. This is formed from the 3rd Person Plural, Present Tense, Indicative, by rejecting the ending -тъ.

Examples

3rd Plural, Present	*Gerund, Present*
Они́ говоря́тъ, *they speak, say.*	Говоря́, *speaking.*
Они́ су́дятъ, *they judge.*	Суд*я́*, *judging.*
Они́ смо́трятъ, *they look.*	Смотря́, *looking.*
Они́ нахо́дятъ, *they find.*	Находя́, *finding.*
Они́ перехо́дятъ, *they pass.*	Переходя́, *passing.*

172. If the ending -тъ of the 3rd Person Plural, Present Tense, is preceded by у or ю, they are changed to я.

Examples

3rd Person Plural, Present	*Gerund, Present*
Они́ иду́тъ, *they go.*	Идя́, *going.*
Они́ веду́тъ, *they conduct.*	Ведя́, *conducting.*
Они́ несу́тъ, *they carry, bear.*	Неся́, *carrying, bearing.*
Они́ плыву́тъ, *they sail.*	Плыв*я́*, *sailing.*
Они́ зову́тъ, *they call.*	Зовя́, *calling.*
Они́ рабо́таютъ, *they work.*	Рабо́тая, *working.*
Они́ чита́ютъ, *they read.*	Чита́я, *reading.*
Они́ покупа́ютъ, *they buy.*	Покупа́я, *buying.*
Они́ отправля́ютъ, *they send off.*	Отправля́я, *sending off.*
Они́ объясня́ютъ, *they explain.*	Объясня́я, *explaining.*
Они́ и́мѣютъ *they have.*	И́мѣя, *having.*
Они́ жалѣ́ютъ, *they regret.*	Жалѣ́я, *regretting.*

173. If the 3rd Plural Present ends in -жать, -чать, -шать, or -щать, the Rule 171 is followed out by rejecting -тъ and using the remainder of the verb.

Examples

Они́ содержа́тъ, *they contain.*	Содержа́, *containing.*
Они́ кричатъ, *they shout.*	Крича́, *shouting.*
Они́ спѣша́тъ, *they are in a hurry.*	Спѣша́, *hurrying.*
Они́ пища́тъ, *they squeak.*	Пища́, *squeaking.*

The Gerund, Past Tense, Active

174. This is formed from the Singular Past by rejecting the ending -лъ, and adding -въ or -вши instead.

Examples

Singular, Past	*Gerund, Past*
Онъ говори́лъ, *he spoke.*	Говори́вши, *having spoken.*
Онъ суди́лъ, *he judged.*	Суди́вши, *having judged.*
Онъ смотре́лъ, *he looked.*	Смотре́вши, *having looked.*
Онъ находи́лъ, *he found.*	Находи́вши, *having found.*
Онъ переходи́лъ, *he passed.*	Переходи́вши, *having passed.*
Онъ плылъ, *he sailed.*	Пла́вши, *having sailed.*
Онъ звалъ, *he called.*	Зва́вши, *having called.*
Онъ рабо́талъ, *he worked.*	Рабо́тавши, *having worked.*
Онъ чита́лъ, *he read.*	Чита́въ, *having read.*
Онъ имѣлъ, *he had.*	Имѣ́въ, *having had.*

175. The following are a few exceptions to the preceding rule:

Онъ вёлъ, *he conducted.*	Ве́дши, *having conducted.*
Онъ шёлъ, *he went.*	Ше́дши, *having been going.*
Онъ нёсъ, *he carried.*	Не́сши, *having carried.*
Онъ стёръ, *he wiped off.*	Сте́рши, *having wiped off.*

Numbers

Cardinal Numbers.		*Ordinal Numbers.*	
Оди́нъ, m. / Одна́, f. / Одно́, n.	1	Пе́рвый / Пе́рвая / Пе́рвое	1st
Два, m., n. / Двѣ, f.	2	Второ́й-а́я-о́е	2nd
Три	3	Тре́тій-ья-ье	3rd
Четы́ре	4	Четве́ртый-ая-ое	4th
Пять	5	Пя́тый-а́я-о́е	5th
Шесть	6	Шесто́й-а́я-о́е	6th
Семь	7	Седьмо́й-а́я-о́е	7th
Во́семь	8	Восьмо́й-а́я-о́е	8th
Де́вять	9	Девя́тый-ая-ое	9th
Де́сять	10	Деся́тый-ая-ое	10th
Оди́надцать	11	Оди́надцатый-ая-ое	11th
Двѣна́дцать	12	Двѣна́дцатый-ая-ое	12th
Трина́дцать	13	Трина́дцатый-ая-ое	13th
Четырна́дцать	14	Четырна́дцатый-ая-ое	14th
Пятна́дцать	15	Пятна́дцатый-ая-ое	15th
Шестна́дцать	16	Шестна́дцатый-ая-ое	16th
Семна́дцать	17	Семна́дцатый-ая-ое	17th
Восемна́дцать	18	Восемна́дцатый-ая-ое	18th
Девятна́дцать	19	Девятна́дцатый-ая-ое	19th
Два́дцать	20	Двадца́тый-ая-ое	20th
Два́дцать оди́нъ (одна́, одно́)	21	Два́дцать пе́рвый-ая-ое	21st
Два́дцать два (двѣ)	22	Два́дцать второ́й-а́я-о́е	22nd
Два́дцать три	23	Два́дцать тре́тій-ья-ье	23rd
Два́дцать четы́ре	24	Два́дцать четве́ртый-ая-ое	24th
Два́дцать пять	25	Два́дцать пя́тый-ая-ое	25th
Два́дцать шесть	26	Два́дцать шесто́й-а́я-о́е	26th
Два́дцать семь	27	Два́дцать седьмо́й-а́я-о́е	27th
Два́дцать во́семь	28	Два́дцать восьмо́й-а́я-о́е	28th
Два́дцать де́вять	29	Два́дцать девя́тый-ая-ое	29th
Три́дцать	30	Тридца́тый-ая-ое	30th
Со́рокъ	40	Сороково́й-а́я-о́е	40th
Пятьдеся́тъ	50	Пятидеся́тый-ая-ое	50th
Шестьдеся́тъ	60	Шестидеся́тый-ая-ое	60th
Се́мьдесятъ	70	Семидеся́тый-ая-ое	70th
Во́семьдесятъ	80	Восьмидеся́тый-ая-ое	80th
Девяно́сто	90	Девяно́стый-ая-ое	90th
Сто	100	Со́тый-ая-ое	100th
Сто со́рокъ семь	147	Сто со́рокъ седьмо́й-а́я-о́е	147th
Двѣсти	200	Двухсо́тый-ая-ое	200th
Три́ста	300	Трёхсо́тый-ая-ое	300th
Четы́реста	400	Четырёхсо́тый-ая-ое	400th
Пятьсо́тъ	500	Пятисо́тый-ая-ое	500th
Шестьсо́тъ	600	Шестисо́тый -ая-ое	600th
Семьсо́тъ	700	Семисо́тый-ая-ое	700th
Восемьсо́тъ	800	Восьмисо́тый-ая-ое	800th
Девятьсо́тъ	900	Девятисо́тый-ая-ое	900th
Ты́сяча	1,000	Ты́сячный-ая-ое	1,000th
Двѣ ты́сячи	2,000	Двухты́сячный-ая-ое	2,000th
Двѣ ты́сячи семьсо́тъ три́дцать семь	2,737	Двѣ ты́сячи семьсо́тъ три́дцать седьмо́й-а́я-о́е	2,737th
Три ты́сячи	3,000	Трёхты́сячный-ая-ое	3,000th
Четы́ре ты́сячи	4,000	Четырёхты́сячный-ая-ое	4,000th
Пять ты́сячъ	5,000	Пятиты́сячный-ая-ое	5,000th
Шесть ты́сячъ	6,000	Шеститы́сячный-ая-ое	6,000th
Де́сять ты́сячъ	10,000	Десятиты́сячный-ая-ое	10,000th
Пятьдеся́тъ ты́сячъ	50,000	Пятидесяти-ты́сячный-ая-ое	50,000th
Сто ты́сячъ	100,000	Стоты́сячный	100,000th
Двѣсти ты́сячъ	200,000	Двѣститы́сячный	200,000th
Девятьсо́тъ ты́сячъ	900,000	Девятисотъ ты́сячный-ая-ое	900,000th
Милліо́нъ	1,000,000	Милліо́нный-ая-ое	1,000,000th

N.B.—For the expression of any composite cardinal number the student will be best guided by the examples 147 and 2,737 in the above columns. In expressing composite ordinal numbers the student will take care to express only the units ordinally, while the other figures must remain cardinal, as exemplified by the numbers 147th and 2737th in the above columns.

The declensions and the other rules in connection with numbers will be dealt with later.

Fractions

Полови́на, *a half.*
Треть, *a third.*
Двѣ тре́ти, *two-thirds.*
Че́тверть, *a quarter.*
Три че́тверти, *three-quarters.*

176. Any other fraction is expressed by an ordinal number in feminine, followed sometimes by the words часть or до́ля, both meaning *part.*

Examples

Одна́ пя́тая, *one-fifth.*
Три седьмыхъ, *three-sevenths.*
Одна́ со́тая часть, *one hundredth part.*
Одна́ ты́сячная до́ля, *one thousandth.*

VOCABULARY

Стать (P.), *to become.*
Самъ, *himself.*
Благоволи́ть (Imp.), *to be good enough.*
Отдѣ́льный, *separate.*
Спра́шивать (Imp.), *to ask for.*
Возобнови́ть (P.), *to renew.*
Приня́ть (P.), *to take for.*
Просма́тривать (Imp.), *to look through.*
Послѣ́дній, *the last.*
Найти́ (P.), *to find.*
Перебо́ръ, *an overcharge.*
Заключа́ть (Imp.), *to close up.*
Прія́тно, *pleasant.*
Покры́тіе, *covering.*
Бо́чка, *a barrel.*
Зна́читься (Imp.), *to figure.*
Факту́ра, *the invoice.*
Оказа́ться (P.), *to be found.*
Уте́чка, *a leakage.*
Я́щикъ, *the case, box.*
Прибы́ть (P.), *to land.*
Соверше́нно, *quite.*
Взлома́ть (P.), *to break up.*
Посчита́ть (P.), *to charge.*
Гроссъ, *a gross.*
Каранда́шъ, *a pencil.*
Не хвата́ть (Imp.), *to be short.*
Дю́жина, *a dozen.*
Замѣ́тить (P.), *to notice.*
Дыра́, *a hole.*
Обра́тно, *back.*
Отходи́ть (Imp.), *to go off.*
Вниманіе, *consideration, attention.*
Объясне́ніе, *explanation.*
Верну́ть (P.), *to refund.*
Понести́ (P.), *to sustain.*
Убы́тки, *losses.*
Разсужда́ть (Imp.), *to judge, deliberate.*
Нра́вственный, *moral.*
То́чка зрѣ́нія, *point of view.*
Поступи́ть (P.), *to act.*
Недобросо́вѣстно, *unfairly.*
Пригото́вить (P.), *to prepare.*
Колле́кція, *a set.*
Заключа́ть (Imp.), *to contain.*
Въ себѣ́, *in itself.*
Сто́йко, *firmly.*
Держа́ться (Imp.), *to adhere.*
Пока́, *meanwhile.*
Коли́чество, *quantity.*
На основа́ніи, *on the basis.*
Регуля́рный, *regular.*
Смѣ́ть (Imp.), *to take the liberty.*
Запроси́ть (P.), *to ask.*
Почему́, *why.*
Удосто́ить (P.), *to favour, honour.*
Извѣ́стіе, *news.*
Такъ до́лго, *so long.*
Семе́йный, *family* (Adj.).
Обстоя́тельство, *matter, circumstance.*
Отвле́чь (P.), *to draw away.*
Обраща́ть (Imp.), *to draw to.*
Маши́на, *machine.*
Января́скій, *of January.*
Въ виду́, *in view.*
Предстоя́ть (Imp.), *to stand before.*
Кру́пный, *huge.*
Плате́жъ, *payment.*
Вы́нужденъ, *compelled.*
Слѣ́довать (Imp.), *to be owing, due.*
Мартъ, *March.*
Тре́боваться (Imp.), *to be required.*
Не имѣ́ться (Imp.), *not to be extant.*
Складъ, *warehouse, stock.*
Замѣни́ть (P.), *to replace.*
Перебра́ть (P.), *to take more, overcharge.*
Прости́ть (P.), *to forgive.*
Пожа́луйста, *please!*
Недосмо́тръ, *an oversight.*
Намѣ́реваться (Imp.), *to intend.*
Разсчита́ться (P.), *to settle.*
Сперва́, *first.*
Тако́й оборо́тъ, *such a turnover.*
Заслу́живать (Imp.), *to deserve.*
Спеціа́льный, *special.*
Усту́пка, *allowance.*
Уступа́ть (Imp.), *to make an allowance.*
Долгъ, *debt.*
Находи́ть (Imp.), *to find.*
Тепе́решній, *present.*
Ры́нокъ, *market.*
Неусто́йчивый, *unstable.*
Рѣши́ть (P.), *to decide.*
Воздержа́ться (P.), *to abstain.*
Разсчи́тывать (Imp.), *to reckon.*
Ско́рое, *speedy, early.*
Пониже́ніе, *dropping, diminution.*
Обезпе́чить за (P.), *to secure for.*
Удо́бный, *propitious.*
Слу́чай, *opportunity.*
Егѝпетскій, *Egyptian.*
Пря́жа, *yarns.*
Прядѝльщикъ, *spinner.*
Находи́ться (Imp.), *to be* (situated) *in.*
Уже́, *already.*
Распрода́ть (P.), *to sell out, off.*
Отдѣли́ть (P.), *to put apart.*
Тѣ, *those.*
Тюкъ, *a bale.*
Большо́й ско́ростью, *per express, per "Grande vitesse."*
Вы́писать (P.), *to make out, write out.*
Имя́, *name.*
На́ртія, *a lot of goods, item, transport.*
Вы́ставить перево́дъ (P.), *to draw, issue a draft.*
По предъявле́нію, *at sight.*

Exercise 26

1. Господи́нъ, управля́вшій на́шимъ дѣ́ломъ, сталъ сво́имъ хозя́иномъ.

2. Да́нный Вамъ мно́ю зака́зъ благово́льте вы́слать въ трёхъ отдѣ́льныхъ отпра́вкахъ.

3. Пе́рвую отпра́вку мо́жете сдѣ́лать въ Февралѣ́.

4. Спра́шиваемый Ва́ми но́меръ три ты́сячи пятьсо́тъ семна́дцать не мо́жетъ быть возобновлёнъ.

5. Суда́ по Ва́шей телегра́ммѣ, я её при́нялъ за но́вый зака́зъ.

6. Просма́тривая Вашъ послѣ́дній счётъ, я въ нёмъ нашёлъ два перебо́ра.

7. Заключа́я тепе́рь мои́ кни́ги, мнѣ бы́ло бы прія́тно получи́ть отъ Васъ покры́тіе.

8. Въ бо́чкѣ, зна́чащейся по факту́рѣ подъ но́меромъ двѣ́сти шестьдеся́тъ де́вять, оказа́лась больша́я уте́чка.

9. Ящикъ пятьдеся́тъ восьмо́й прибы́лъ соверше́нно взло́маннымъ.

10. Изъ посчи́танныхъ мнѣ шестидеся́ти гроссъ карандашёй не хвата́ло пя́ти дю́жинъ.

11. Разсмотрѣ́вши Вашъ но́воприбы́вшій това́ръ, я замѣ́тилъ въ одно́мъ изъ куско́въ двѣ́ большія дыры́.

12. Не имѣ́я возмо́жности прода́ть его́, я Вамъ отошлю́ его́ обра́тно.

13. Я пошлю́ Вамъ покры́тіе съ пе́рвой отходя́щей по́чтой.

14. Принима́я во вниманіе Ва́ше объясне́ніе, я согла́сенъ верну́ть Ва́мъ понесе́нные убы́тки.

15. Разсужда́я съ нра́вственной то́чки зрѣ́нія, Вы поступи́ли съ Ва́шимъ бы́вшимъ управля́ющимъ недобросо́вѣстно.

16. Мы пригото́вили для Васъ но́вую колле́кцію, заключа́ющую въ себѣ́ семьсо́тъ пятна́дцать образцо́въ.

17. Находя́ тепе́решній ры́нокъ неусто́йчивымъ, мы рѣши́ли воздержа́ться зака́зомъ.

18. Разсчи́тывая на ско́рое пониже́ніе цѣнъ, про́симъ Васъ обезпе́чить за на́ми при пе́рвомъ удо́бномъ слу́чаѣ со́рокъ ты́сячъ фу́нтовъ Егѝпетской пря́жи.

Exercise 27

1. On the basis of your regular orders we take the liberty of asking you why you have not favoured us with your news so long.

2. Family matters have drawn my attention away from business.

3. We draw your attention to our new machine 659. (Translate in words.)

4. In looking through your account we find that you have not yet sent us any cover for the January shipment.

5. In view of our impending (beforestanding) huge payments we are compelled to ask you to send us two hundred (omit *and*) seventeen pounds, owing (owed) by you since March.

6. We thank you for the draft forwarded.

7. The number seventy-seven you require is not in stock.

A. C.

GREEK.—IV

Adjectives of the Third Declension

Most adjectives of the third declension are of two terminations, ending in -ης and -ες or -ων and -ον. Σαφής, -ές, *clear, plain*, and εὐδαίμων, -ον, *happy*, are declined as follows:—

Singular.

	Masc.	*Fem.*	*Neut.*	*Masc.*	*Fem.*	*Neut.*
Nom.	σαφής		σαφές	εὐδαίμων		εὔδαιμον
Gen.	σαφοῦς			εὐδαίμονος		
Dat.	σαφεῖ			εὐδαίμονι		
Acc.	σαφῆ		σαφές	εὐδαίμονα		εὔδαιμον
Voc.	σαφές			εὔδαιμον		

Plural.

N.V.	σαφεῖς	σαφῆ	N.V.	εὐδαίμονες		εὐδαίμονα
Gen.	σαφῶν			εὐδαιμόνων		
Dat.	σαφέσι			εὐδαίμοσι		
Acc.	σαφεῖς	σαφῆ		εὐδαίμονας		εὐδαίμονα

Dual.

N.A.V.	σαφέ-ε, σαφῆ	εὐδαίμονε
G.D.	σαφέ-οιν, σαφοῖν	εὐδαιμόνοιν

After these models decline ἀληθής, -ές, *true*, and πέπων, -ον, *ripe*.

Adjectives ending in ης preceded by a vowel are contracted, εα becoming α. Thus ὑγιής -ές, *healthy*, usually has in the acc. sing. masc. and in the nom. and acc. neut. pl. ὑγιᾶ for ὑγιέα.

Some adjectives of this declension have only one declension (being either masculine or feminine, not neuter), as φυγάς, gen. φυγάδος, *banished, fugitive*; ἄπαις, gen. ἄπαιδος, *childless*; and, ἀγνώς, gen. ἀγνῶτος, *unknown*.

With these may be grouped various adjectives formed by combination with nouns, which are usually declined like those nouns. εὔχαρις, *graceful*, ἄναλκις, *strengthless*, and τρίπους, *three-footed*, are declined as follows:—

Singular.

	M.	*F.*	*N.*	*M.*	*F.*	*N.*
Nom.	εὔχαρις		εὔχαρι	ἄναλκις		ἄναλκι
Gen.	εὐχάριτος			ἀνάλκῐ̈ος		
Dat.	εὐχάριτι			ἀνάλκῐ̈δι		
Acc.	εὔχαριν		εὔχαρι	ἀνάλκιδα (poet. -ιν)		ἄναλκι
Voc.	εὔχαρι			ἄναλκι		

Plural.

N.V.	εὐχάριτες	εὐχάριτα	ἀνάλκιδες		ἀνάλκιδα
Gen.	εὐχαρίτων		ἀναλκίδων		
Dat.	εὐχάρισι (ν)		ἀνάλκισι (ν)		
Acc.	εὐχάριτας	εὐχάριτα	ἀνάλκιδας		ἀνάλκιδα

Dual.

N.A.V.	εὐχάριτε	ἀνάλκιδε
G.D.	εὐχαρίτοιν	ἀναλκίδοιν

	Singular.			*Dual.*	*Plural.*		
	M.	*F.*	*N.*		*M.*	*F.*	*N.*
N.V.	τρίπους	τρίπους	τρίπουν	τρίποδε	τρίποδες	τρίπους	τρίποδα
Gen.	τρίποδος			τριπόδοιν	τριπόδων.		
Dat.	τρίποδι				τρίποσι (ν)		
Acc.	τρίποδα	τρίπους	τρίπουν		τρίποδας	τρίπους	τρίποδα

εὔελπις, εὔελπι, *confident*, has acc. sing. masc. εὔελπιν.

Adjectives of Three Terminations

Most adjectives of three terminations end in υς, εια, and υ, or in εις εσσα, and εν. γλυκύς, -εῖα, -ύ, *sweet*, and χαρίεις, -εσσα, -εν, *graceful*, are declined as follows:—

Singular.

	Masc.	*Fem.*	*Neut.*
Nom.	γλυκύς	γλυκεῖα	γλυκύ
Gen.	γλυκέ-ος	γλυκείας	γλυκέ-ος
Dat.	(γλυκέϊ) γλυκεῖ	γλυκείᾳ	(γλυκέϊ) γλυκεῖ
Acc.	γλυκύν	γλυκεῖαν	γλυκύ
Voc.	γλυκύ	γλυκεῖα	γλυκύ

Plural.

N.V.	(γλυκέες) γλυκεῖς	γλυκεῖαι	γλυκέα
Gen.	γλυκέων	γλυκειῶν	γλυκέων
Dat.	γλυκέσι	γλυκείαις	γλυκέσι
Acc.	(γλυκέας) γλυκεῖς	γλυκείας	γλυκέα

Dual.

N.A.V.	γλυκέε	γλυκεῖα	γλυκέε
G.D.	γλυκέοιν	γλυκείαιν	γλυκέοιν

Singular.

	Masc.	*Fem.*	*Neut.*
Nom.	χαρίεις	χαρίεσσα	χαρίεν
Gen.	χαρίεντος	χαριέσσης	χαρίεντος
Dat.	χαρίεντι	χαριέσσῃ	χαρίεντι
Acc.	χαρίεντα	χαρίεσσαν	χαρίεν
Voc.	χαρίεν	χαρίεσσα	χαρίεν

Plural.

Nom.	χαρίεντες	χαρίεσσαι etc.	χαρίεντα

To this class belong the adjectives μέλας, *black* like which is declined τάλας, τάλαινα, τάλαν, *unhappy*, and πᾶς, *all*. The first and last are declined thus:—

Singular.

	Masc.	*Fem.*	*Neut.*
N.V.	μέλᾱς	μέλαινα	μέλᾰν
Gen.	μέλᾰνος	μελαίνης	μέλᾰνος
Dat.	μέλανι	μελαίνῃ	μέλανι
Acc.	μέλανα	μέλαιναν	μέλᾰν
Voc.	μέλαν	μέλαινα	μέλᾰν

Plural.

N.V.	μέλανες	μέλαιναι etc.	μέλανα

Singular.

	Masc.	*Fem.*	*Neut.*
Nom.	πᾶς	πᾶσα	πᾶν
Gen.	παντός	πάσης	παντός
Dat.	παντί	πάσῃ	παντί
Acc.	πάντα	πᾶσαν	πᾶν

Plural.

Nom.	πάντες	πᾶσαι	πάντα
Gen.	πάντων	πασῶν	πάντων
Dat.	πᾶσι (ν)	πάσαις	πᾶσι(ν)
Acc.	πάντας	πάσας	πάντα

The adjective ἑκών, *willing*, is also of three terminations; and is thus declined:—

Singular.

	Masc.	*Fem.*	*Neut.*
Nom.	ἑκών	ἑκοῦσα	ἑκόν
Gen.	ἑκόντος	ἑκούσης	ἑκόντος
Dat.	ἑκόντι	ἑκούσῃ	ἑκόντι
Acc.	ἑκόντα	ἑκοῦσαν	ἑκόν
Voc.	ἑκών	ἑκοῦσα	ἑκόν

		Plural.	
Nom.	ἑκόντες	ἑκοῦσαι	ἑκόντα
Gen.	ἑκόντων	ἑκουσῶν	ἑκόντων
Dat.	ἑκοῦσι (ν)	ἑκούσαις	ἑκοῦσι (ν)
Acc.	ἑκόντας	ἑκούσας	ἑκόντα
Voc.	ἑκόντες	ἑκοῦσαι	ἑκόντα
		Dual.	
N.A.V.	ἑκοντε		
G.D.	ἑκόντοιν		

So also ἄκων (ἀέκων), ἄκουσα, ἄκον, *unwilling.* The active and the aorist passive participles belong to this class. Participles in -ων, -ουσα, -ον, as λύων, λύουσα, λῦον, *loosing,* and λύσων, λύσουσα, λῦσον, *about to loose,* are declined like ἑκών, ἑκοῦσα, ἑκόν. So also in the oblique cases is the participle διδούς, διδοῦσα, διδόν, *giving,* from δίδωμι, *I give.* Participles in -ας, -ᾶσα, -αν, as λύσας, λύσᾶσα, λῦσαν, *having loosed* or *loosing,* and in -θεις, -θεισα, -θεν, or -εις, -εισα, -εν, as λυθείς, λυθεῖσα, λυθέν, *loosed* or *having been loosed,* and perfect active participles as λελυκώς, λελυκυῖα, λελυκός, *having loosed,* are declined after the following models respectively :—

		Singular.	
	Masc.	*Fem.*	*Neut.*
N.V.	λύ-σας	λύ-σᾶσα	λῦ-σαν
Gen.	λύ-σαντος	λυ-σάσης	λύ-σαντος
Dat.	λύ-σαντι	λυ-σάσῃ	λύ-σαντι
Acc.	λύ-σαντα	λύ-σᾶσαν	λῦ-σαν
		Dual.	
N.A.V.	λύ-σαντε	λυ-σάσα	λύ-σαντε
G.D.	λυ-σάντοιν	λυ-σάσαιν	λυ-σάντοιν
		Plural.	
N.V.	λύ-σαντες	λύ-σασαι	λύ-σαντα
Gen.	λυ-σάντων	λυ-σασῶν	λυ-σάντων
Dat.	λύ-σασι	λυ-σάσαις	λύ-σασι
Acc.	λύ-σαντας	λυ-σάσας	λύ-σαντα
		Singular.	
	Masc.	*Fem.*	*Neut.*
N.V.	λυθείς	λυθεῖσα	λυθέν
Gen.	λυθέντος	λυθείσης	λυθέντος
Dat.	λυθέντι	λυθείσῃ	λυθέντι
Acc.	λυθέντα	λυθεῖσαν	λυθέν
		Dual.	
N.A.V.	λυθέντε	λυθείσα	λυθέντε
G.D.	λυθέντοιν	λυθείσαιν	λυθέντοιν
		Plural.	
N.V.	λυθέντες	λυθεῖσαι	λυθέντα
		etc.	
		Singular.	
	Masc.	*Fem.*	*Neut.*
N.V.	λελυ-κώς	λελυ-κυῖα	λελυ-κός
Gen.	λελυ-κότος	λελυ-κυίας	λελυ-κότος
Dat.	λελυ-κότι	λελυ-κυίᾳ	λελυ-κότι
Acc.	λελυ-κότα	λελυ-κυῖαν	λελυ-κός
		Dual.	
N.A.V.	λελυ-κότε	λελυ-κυία	λελυ-κότε
G.D.	λελυ-κότοιν	λελυ-κυίαιν	λελυ-κότοιν
		Plural.	
N.V.	λελυ-κότες	λελυ-κυῖαι	λελυ-κότα
Gen.	λελυ-κότων	λελυ-κυιῶν	λελυ-κότων
Dat.	λελυ-κόσι	λελυ-κυίαις	λελυ-κόσι
Acc.	λελυ-κότας	λελυ-κυίας	λελυ-κότα

Δεικνύς, δεικνῦσα, δεικνύν, *showing,* present participle active of δείκνυμι, *I show* (stem δείκνυντ-), has dative plural δεικνῦσι(ν), δεικνύσαις, δεικνῦσι(ν).

Adjectives of One Termination

These include a small number of adjectives having the same form for masculine and feminine and, from their meaning, rarely used in the neuter. Whenever so used the same forms are taken as in the masculine, except that the neut. nom. and acc. plur. end in α. Examples are αἰγίλιψ, αἰγίλῑπος, *lofty (destitute of goats)* ; ἅρπαξ, ἅρπᾰγος, *rapacious* ; ἥλιξ, ἥλῐκος, *of the same age* ; μώνυξ, μώνῡχος, *one-hoofed, having solid hoofs* ; and πένης, πένητος, *poor.*

Notes on the Construction of Sentences

The instrument or means by which an action is performed is denoted by a substantive in the dative case, as πρίατο κτεάτεσσιν ἑοῖσιν, *he bought with his goods,* or ἠχοῖ πολλάκις δολούμεθα, *we are often deceived by echo.*

On the other hand, the personal agent with a passive is denoted by a substantive in the genitive case governed by ὑπό, *by,* as in ὁ ἥρως ᾄδεται ὑφ' Ὁμήρου, *the hero is sung by Homer.*

The Dative is also used to express the manner, circumstances, etc., of the action denoted by the verb, as βίᾳ, *by force,* σπουδῇ, *with zeal,* ταύτῃ, *in this manner, thus.*

As in Latin, the dative is often employed with the verb εἶναι, *to be,* to denote that a thing belongs to the person or thing represented by the noun in the dative case, as πολλά κτήματα τῷ ἀνθρώπῳ ἐστι, *the man has many possessions (many possessions are to the man).*

The genitive is used to express the time within which anything takes place, as in τῆς νυκτός or νυκτός, *in the night* or *at night* (but τὴν νύκτα would mean *throughout the night*), or χειμῶνος, *in winter.*

The neuter singular of an adjective is often used with the definite article to denote the quality in the abstract sense, as in τὸ δεινόν, *danger* ; τὸ καλόν, *the beautiful* or *beauty.* Similarly a participle may be used with the article, as τὰ γεγενημένα, *the things that have taken place* or *the events* ; τὸ αἰτούμενον, *that which is asked for.* The adjective when used attributively is placed between the article and its substantive, as in τὰ μεγάλα δῶρα, *the great gifts.* When it is used as predicate it is placed outside the article and substantive, as in τὰ δῶρα μεγάλα ἐστι, *the gifts are great.* These constructions agree of course with English idiom. When a superlative adjective occurs as a predicate or part of one it is used without an article, as in τὸ δῶρόν ἐστι μέγιστον πάντων, *the gift is the greatest of all.*

Note position of possessive pronouns, as in ἡ ἐμὴ μήτηρ, *my mother*, ἡ ἐμαυτοῦ οἰκία, *my own house*.

The possessive pronoun is commonly omitted, where we should use it in English, if there is no need to emphasise the idea of possession, as in τὰς χεῖρας νίζομαι, *I wash my hands*.

The Greeks favoured such phrases as τοῖς τοῦ διδασκάλου λόγοις, *with the words of the teacher*. The article may be repeated before an attributive adjective, as in ὁ ἀνὴρ ὁ σοφός, *the wise man*, τὸ φῶς τὸ ἀληθινόν, *the true light*, τὸν ἄνδρα τὸν ἐξ Ἀθηνῶν, *the man from Athens*.

Substantives in the neuter plural require their verb to be in singular number, as Τὰ τέκνα ἀγαθά ἐστιν, *the children are good*.

The definite article is often employed elliptically in such phrases as οἱ ἐκ τῶν Ἀθηνῶν, *the people from Athens*; οἱ τότε ἄνθρωποι, *the men of that time*, οἱ ἐκεῖ, *those (who were) there*; τὰ ἔπειτα, *what happened afterwards*.

The neuter article τό is regularly used with the infinitive to form a verbal substantive, as τὸ εἶναι, *being*, and the article may be declined.

The radical meaning of πᾶς is *all* or *the whole*. Usually, in Attic prose, in the sense of *the whole* it is placed with the definite article in the predicative order, as in πᾶσα ἡ χώρα or ἡ χώρα πᾶσα, *the whole country*, πᾶσαν τὴν νύκτα, *all night long*. Sometimes the same order as in English is followed, as in ἡ πᾶσα χώρα. It is placed in the predicative position when it means *all*, as in πᾶσαι αἱ γυναῖκες, *all the women*; but πᾶσαι πόλεις, *all cities*, πάντες ἄριστοι, *all the best*, πᾶς τις, *every single one*.

The neuter plural πάντα is used in the sense of *all* or *all kind of things*; in the dative πᾶσι, *in all things, entirely*, or *altogether*.

VOCABULARY

ἄγω, *I lead, I drive.*
ἀληθινός, ή, -όν, *true.*
ἀπέχομαι, *I abstain from.*
ἀστραπή, ἡ, *lightning.*
βουλή, ἡ, *counsel.*
βροντή, ἡ, *thunder.*
βαίνω, *I go.*
Βορέας, -ου, ὁ, *the north wind, Boreas.*
δίαιτα, ἡ, *mode of life.*
δίκη, ἡ, *justice, judgment.*
ἔργον, τό, *deed, work.*
ἐσθλός, -ή, -όν, *good, honest.*
εὐδαιμονία, ἡ, *happiness.*
θάνατος, ὁ, *death.*
θαυμαστός, -ή, -όν, *admirable.*
θεῖος, -α, -ον, *divine.*
τὸ θεῖον, *the divinity.*
κακός, -ή, -όν, *bad, wicked.*
κάλως -ω, ὁ, *rope.*
λαμπρός, -ά, -όν, *shining, bright.*
λόγος, ὁ, *word, saying, speech.*
μανθάνω, *I learn.*
μεταβολή, ἡ, *change, vicissitude.*
μύριος, -α, -ον, *innumerable.*
ναναγία, ἡ, *shipwreck.*
νέος, -α, ον, *young*, ὁ νέος, *young man.*
πενία, ἡ, *poverty.*
πολλάκις, *often.*
πόνος ὁ, *labour, toil.*
προσήκει, *it befits.*
ῥᾳδίως, *easily.*
Σάμιος, ὁ, *Samian.*
σοφία, ἡ, *wisdom.*
στρατιώτης, ὁ, *soldier.*
φέρω, *I bear.*
φιλία, ἡ, *friendship.*
κλέπτης, -ου, ὁ, *thief.*
ἀγορά, -ᾶς, ἡ, *assembly, market-place.*
ἀεί, *always, for ever.*
ἀκρατής, -ές, *immoderate, intemperate.*
ἀλλά, *but.*
ἄνθος, τό, *flower.*
ἀτυχής, -ές, *unfortunate.*
βίος, ὁ, *life.*
γῆ, γῆς, ἡ, *the earth.*
γίγας, ὁ, *giant.*
γύνη, γύναικός, ἡ, *woman.*
δέησις, -εως, ἡ, *request, entreaty.*
δέχομαι, *I receive.*
δίδάσκω, *I teach.*
διδάσκομαι, *I learn.*
δμώς, ὁ, *slave.*
ἐλεαίρω, *I pity.*
ἐλέφας, -αντος, ὁ, *elephant, ivory.*
ἦν, *was.*
Ἡρακλῆς, -έους, ὁ, *Heracles (Hercules).*
κεφαλή, ἡ, *head.*
κλέος, τό, *glory, fame*; plur. *glorious deeds.*
κρίνω, *I judge.*
λέγω, *I speak, I say, I utter.*
χαλεπός -ή -όν, *difficult, troublesome.*
Λιβύη, -ης, ἡ, *Libya.*
λυπηρός, -ά, -όν, *sad, miserable.*
μαθητής, -οῦ, ὁ, *pupil, disciple.*
μάντις, -εως, ὁ, *prophet.*
μῆκος, τό, *length.*
μουσικός, -ή, -όν, *of the Muses.*
ἡ μουσική (τέχνη), *music.*
οἰκία, -ας, ἡ, *dwelling.*
οἶκος, ὁ, *house.*
παρέχω, *I supply, provide*, or *bring.*
ποτέ, *once* (enclitic), *at some time or other.*
συμφωνέω, *I agree in sound.*
σώζω, *I save, preserve*, or *keep.*
σωτηρία, -ας, ἡ, *salvation.*
τύπτω, *I strike.*
τύπτομαι, *I am hit* or *wounded.*
φυλάττω, *I watch, guard*, or *keep.*
χρόνος, ὁ, *time.*
ψεῦδος, -εος, τό, *lie, falsehood.*

Exercise 3

Translate into English :—

1. Ἀληθιναὶ φιλίαι διὰ ἀρετῆς γίγνονται. 2. Ῥᾳδίως φέρουσι τὴν πενίαν. 3. Ἡ πενία φέρεται ῥᾳδίως. 4. Μανθάνετε, ὦ νεανίαι, τὴν σοφίαν. 5. Ἡ σοφία μανθάνεται. 6. Οἱ τῆς δόξης ἐρασταὶ οὐ φεύγουσι.

Translate into Greek :—

1. You bear poverty easily. 2. Thunder comes from bright lightning. 3. Virtue is of good repute. 4. Lead a good life. 5. Fortune often has (or brings) vicissitudes. 6. Abstain from troublesome cares.

Exercise 4

(*a*) Translate into English :—

1. Οἱ παῖδες τὴν μουσικὴν διδάσκονται. 2. Τὰ ἔργα τοῖς λόγοις οὐ συμφωνεῖ. 3. Τύπτομαι τὴν κεφαλήν. 4. Νοσῶ τοὺς ὀφθαλμούς. 5. Ὁ μάντις τοὺς λόγους ψευδεῖς λέγει. 6. Οἱ ἐκ τῆς ἀγορᾶς φεύγουσι.

(*b*) Translate into Greek :—

1. Do not speak untruths. 2. We admire the glorious deeds of men. 3. The earth blooms with beautiful flowers. 4. Socrates has many pupils. 5. Always speak the truth, child. 6. O Heracles, bring salvation to the unfortunate.

Key to Exercise 2

(*a*) 1. Many become friends over their cups, but most (or a greater number) become enemies. 2. The lovers of glory do not flee. 3. Do not trust liars. 4. Liars are not lovers of truth. 5. Shun a liar, O Spartan. 6. I admire Hermes.

(*b*) 1. Φεῦγε τοὺς θῆρας. 2. Οἱ στρατιῶται ᾄδουσι παιᾶνα. 3. Τὰς χεῖρας νίζε. 4. Οἱ λειμῶνες θάλλουσιν. 5. Εὔχου τῷ ἴλεῳ θεῷ. 6. Οἱ Ἕλληνες τὸν ἴλεων θεὸν σέβονται.

E. A. B.

ITALIAN.—I

THE aim of this Italian course is to give to the clerk or business man the practical instruction which he will require for the different branches of the export and shipping trade. The course has been so arranged that a person of intelligence and application can in a short time acquire a working knowledge of commercial Italian.*

Alphabet

	(*Pronounced*)
A	ah
B	bee
C	chee
D	dee
E	ay
F	eff-ay
G	jee
H	áhk-kah
I	ee
J	ee loón-go (= long I)
L	ell-ay
M	ém-may
N	én-nay
O	o
P	pee
Q	koo
R	áirr-ray (rough R)
S	és-say
T	tee
U	oo
V	voo
Z	dzáy-tah

Vowels.—These are each pronounced separately when found together, though in the case of **i** and **u**, coming first, they sound more like English Y and W respectively, viz. **pieno**, pyáy-no, **buono**, bwó-no (or rather bwáw-no), i.e. two syllables in each word :—

	Pronunciation
A	ah
E	ay (sometimes ai, as in *stairs*)
I	ee
O	o (sometimes aw, as in *law*)
U	oo

Stress.—The stress or emphasis, unless bearing the grave accent marked on the last vowel, as **bontà**, *goodness*, is on the last syllable but one. Where the acute accent is met with in this work, it is to show an exception to the rule, or to point out clearly the stressed syllable, as **perícolo,** *danger*, and is only so used to guide the student.

* Thanks are due to Mr. A. Valgimigli for kind assistance in revising proofs, etc.

Consonants.—The remaining seventeen letters are consonants, and are all pronounced as in English, except :

Ch	= **K**
C	before **e** or **i** = **ch** as in *chew*.
Sc	before **e** or **i** = **sh** as in *show*.
G	before **e** or **i** = **g** as in *ginger*.
Gl	before **i** = **lli** as in *million*.
Gh	= **g** as in *got*.
Gn	before any vowel = **ni** as in *onion*.
H	is always silent, i.e. not pronounced, for which reason the Italians say of a worthless thing : "**Non vale un' acca,**" *it is not worth an h.*
J	= **y** in *yet*, but **i** now almost always takes its place.
S	between two vowels is generally pronounced like **z** in *lazy*.
S	= **z** at the beginning of a word, when immediately followed by one of the consonants **b**, **d**, **g**, **l**, **m**, **n**, **r**, **v**, as **sbaglio** = zbáhl-yo, *mistake*. An initial **s** followed by any consonant is called **s impura** (impure s).
Z	= **ts**, but also **dz** in a few words of little importance.
ZZ	= **t-ts**, seldom **d-dz**, as in **mezzo**, méd-dzo, *half*.

Double consonants are each pronounced separately, as **sotto** = sót-to, *under*.

Before **a**, **o**, or **u**, the **i** in **ci** or **gi** is scarcely heard, but is required to give the **ch** sound, as in the English word *church*.

Verb.—The infinitive, present and past participles, and present tense of **avere**, *to have*, **essere**, *to be*, are as follows :—

avere, *to have.*	essere, *to be.*
avendo, *having.*	essendo, *being.*
avuto, *had.*	stato, *been.*
(Io)† ho, *I have.*	(Io) sono, *I am.*
(tu) hai, *thou hast.*	(tu) sei, *thou art.*
(egli or esso) ha, *he has.*	(egli or esso) è, *he is.*
(noi) abbiamo, *we have.*	(noi) siámo, *we are.*
(voi) avete, *you have.*	(voi) siete, *you are.*
(eglino or essi) hanno, *they have.*	(eglino or essi) sono, *they are.*
non ho, etc., *I have not*, etc. (**non** always precedes the verb).	sono stato (stata, fem.), etc., *I have* (literally, am) *been*, etc.
	siamo stati (masc. ; state, fem.), etc., *we have been*, etc.
	non sono stato, etc., *I have not been*, etc.

† The Italian pronouns may be omitted entirely in this lesson as they will not be needed.

INFINITIVE

First (or **a**) Conjugation ends in -are, as—
comp**rare**, *to buy*.
Second (or **e**) Conjugation ends in -ere, as—
vénd**ere**, *to sell*.
Third (or **i**) Conjugation ends in -ire, as—
part**ire**, *to depart* (set out, start).

PRESENT PARTICIPLE

1. -ando, as comp**rando**, *buying*.
2. -endo, as vend**endo**, *selling*.
3. -endo, as part**endo**, *departing* (setting out, starting).

PAST PARTICIPLE

1. -ato, as comp**rato**, *bought*.
2. -uto, as vend**uto**, *sold*.
3. -ito, as part**ito**, *departed* (set out, started).

Examples :—

Abbiamo comprato, *We have bought.*
Avete venduto, *You have sold.*
Sono partito, *I have* (*am*, in Italian) *left* (set out, departed).
Sono partiti, *They have* (are) *departed.*

Certain verbs, especially those expressing motion, take the auxiliary **éssere**, *to be*, where *to have* is used in English.

Ho venduto, *I have sold.*
Ha comprato, *He has bought.*
Siamo partiti, *We have* (are) *set out.*
Siete partiti, *You* (plur.) *have* (are) *started.*

In these two examples the plural of **o** is **i**, required here as the past participle with "to be," **éssere**, always agrees in gender (masculine and feminine) and number (singular and plural) with the subject, in this instance, *we*, *you*.

La léttera (fem. sing.) è partit**a** (fem. sing.), *The letter has* (is) *left.*
Le léttere (fem. plur.) sono partit**e** (fem. plur.), *The letters have left.*

Note : **Il**, *the* (masc. sing.) makes I (masc. plur.).

The ending -e in a noun or adjective, whether masculine singular (as here) or feminine singular, makes -i in the plural.

Lo zúcchero (masc. sing.) non è partit**o** (masc. sing.), *The sugar has not left.*
Gli zúccheri (masc. plur.) non sono partit**i** (masc. plur.), *The sugars have not left.*

Note : **Lo**, *the*, before **z** or **s impura** (initial **s** followed by a consonant) makes **gli** in the plural.

Singular **o** makes plural **i**, as already observed.

L'uómo è partito, *The man has started.*
Gli uómini sono partiti, *The men have started.*

Note : **L'** (= **lo**) before a masculine noun in the singular beginning with a vowel, makes **gli** in the plural.

Uómo forms its plural irregularly.

La signora è partita, *The lady has set out.*
Le signore sono partite, *The ladies have set out.*
La donna dice, "Sono stanca," *The lady says, "I am tired."*
Le donne dícono, "Siamo stanche," *The ladies say, "We are tired."*

Note : In "stanche" the h is inserted to keep the k sound of c before e, as c before e and i is always pronounced ch, as in English *church*. The same rule applies to g when we wish to preserve its hard sound, as—

La cassa lunga è partita, *The long case* (box) *has left.*
Le casse lunghe sono partite, *The long cases have left.*

"Lunge" would have been pronounced lún-jay, but the **h** makes it lún-gay.

The Past Participle of a verb together with **éssere**, *to be*, agrees with its subject, as—

vendere, *to sell*
(esso) è vendut**o** (masc. sing.).
(essa) è vendut**a** (fem. sing.).
(essi) sono vendut**i** (masc. plur.).
(esse) sono vendut**e** (fem. plur.).

Past Participles of verbs are given in the foregoing examples :—

	Sing.		*Plur.*		
	Masc.	*Fem.*	*Masc.*	*Fem.*	
comprare, *to buy*	comprato	comprata	comprati	comprate	*bought.*
avere, *to have*	avuto	avuta	avuti	avute	*had.*
essere, *to be*	stato	stata	stati	state	*been.*
partire, *to depart*	partito	partita	partiti	partite	*departed.*
vénedre, *to sell*	venduto	venduta	venduti	vendute	*sold.*

Note : The plural of **a** is **e**.

Il negoziante è partito, *The merchant has* (is) *departed.*
I negozianti sono partiti, *The merchants have* (are) *departed.*

Table of usual endings to which variable parts of speech (articles, nouns, adjectives, pronouns, past participles of verbs after the verb **essere**) are subject :

	Sing.	*Plur.*
Masculine.	-o	-i
Feminine.	-a	-e

In the following vocabulary and other parts of this lesson all words required for translating the exercises will be found. The student is advised to keep a list of such words in each lesson, and to memorise them and the examples thoroughly before attempting to translate, as words already given will not be repeated in later vocabularies. By following out this recommendation his progress will be rendered infinitely easier and far more pleasant.

VOCABULARY

gli stessi (or i medésimi) órdini, *the same orders.*
un órdine (m.), *an order.*
le stesse (or le medésime) commissioni, *the same orders.*
agli uómini, *to the men.*
che, *who, which, that* (conj.).
per, *for.*
Londra, *London.*
durante, *during.*
più, *more.*
nel (= in il) magazzino, *in the warehouse.*
trovare, *to find.*
ad un, *at a, to a.*
il prezzo ragionévole, *the reasonable price.*
la questione, *the question.*
spesso, sovente, *often.*
in bocca, *in the mouth.*
la bocca, *the mouth.*
molto, *much ;* molti (m.), *many.*
volete (from volere), *do you wish ? are you willing ?*
o, *or.*
aspettare, *to wait for, await, expect.*
ancora, *still, yet.*
due, *two.*
tre, *three.*
il collo, *the package.*
il vapore, *the steamer.*
col (= con il) vapore, *with the steamer (= by the steamer).*
menzionato (from menzionare), *mentioned.*
acchiuso, accluso, *enclosed.*
nella (= in la) pólizza di cárico acclusa, *in the enclosed bill of lading.*
il bastimento italiano, *the Italian vessel, ship.*
direttamente per, *directly to (for).*
Génova, *Genoa.*
corto, *short.*
destinare, *to destine, intend.*
qui, *here.*
la merce (pl. -i), *the goods.*
senza, *without.*
senza aspettare, *without awaiting* (lit. *to await*).
nuove istruzioni, *new instructions* (fem. pl.).
caricare, *to ship, to load.*
Nápoli, *Naples.*
dícono (from dire), *they say.*
tanto lavoro, *so much work.*
noi stessi, *we ourselves.*
molto stanchi (m. pl.), *very tired.*
meno di loro, *less than they.*
la opportunità, *the opportunity).*
una véndita (f)., *a sale.*
profittévole (-i, pl., m. and f.), *profitable.*
vantaggioso, *advantageous.*
stretto, *narrow.*
dobbiamo (from dovere), *we must.*
rifiutare, *to refuse.*
stamattina, s t a m a n e, *this morning.*
ci, *to us.*
portato (from portare), *brought.*
poco (pochi, m. ; poca, poche, fem.), *little, few* (if pl.).
la rimessa, *the remittance.*
ci rincresce di dover dirvi, *we are sorry to have to tell you.*
le partite .... ordinate (f. pl., from ordinare), *the lots .... ordered.*
l'anno scorso, *last year.*
il cliente, *the customer, client.*
la qualità, *the quality.*
dopo essere eseguito, *after being executed.*
speriamo (from sperare), *we hope.*
l'indugio (m.), *the delay.*
perchè, *why ?*
vi abbiamo dato, *we have given you.*
parecchie volte, *several times.*
questo, *this.*
la settimana, *the week.*
pronto, *ready.*
lo stesso (or il medésimo) vapore, *t h e s a m e steamer.*
spedito (from spedire), *forwarded.*
la mercanzía (pl. -e), *the goods.*
iersera, *yesterday evening.*
ritornare, *to return.*
di buon'ora, *early.*
mi rincresce di dire, *I am sorry to say.*
così, tanto, *so.*
disposto (-i, m. ; -a, -e, fem.) di *or* ad, *disposed to.*
dalla (= da la), *by the, from the.*

Exercise 1

Translate into English :—

1. Avete comprato un cárico di tremila sacchi di caffé.
cargo of three thousand bags coffee.

2. I nostri viaggiatori sono partiti ieri.
our travellers yesterday.

3. Quando avete ricevuto le léttere ?
when received

4. Hanno venduto tutto il carbone fóssile ?
all coal

5. Non ancora, ma aspéttano domani una consegna di carbone comune.
not but they expect to-morrow a consignment (delivery) charcoal

6. Tutte le balle e le casse di questo cárico sono già vendute.
bales and already

7. Ho ricevuto ieri una léttera da un commesso di questo negoziante.
from clerk

8. Gli zuccheri sono arrivati l'altr'ieri (l'altro ieri) e già sono venduti.
arrived the day before yesterday

9. Oggi i compratori hanno lavorato tutto il giorno e adesso sono stanchi.
to-day buyers worked day now

10. Anch'io (= anche io) sono stanco dopo tanta fatica.
also I (I too) after fatigue.

11. Siamo certi che voi siete molto stanco (sing.).
certain

12. Sono sicuro che le commissioni ricevute sono già eseguite.
sure orders

13. Che cosa dice l'avventore ? Dice che ha dato l'órdine di queste duecento pezze ?
what (thing) says customer he says given of (for) these two hundred pieces

14. Vendendo adesso le esistenze, evitiamo una pérdita considerévole.
by selling stocks we avoid loss considerable
(considerable loss : in Italian, adjectives generally follow nouns).

15. Abbiamo detto francamente ciò che sappiamo di questo affare
said frankly that which we know affair (matter, business).

16. Comprando nuove mercanzíe (merci) abbiamo potuto fare molte véndite profittévoli (vantaggiose) e aumentare la clientela in una
through buying merchandise (or goods) been able to make to increase custom (round of customers, connection)

maniera rimarchévole (notévole).
manner remarkable (notable)

17. Quella pezza è più lunga di questa, ma è
that piece more of (than) this
meno larga.
less wide

18. Le pezze sono troppo strette, sono state ord-
too they have been
inate in ventotto póllici di altezza, perciò non
twenty-eight inches width therefore not
possiamo accettare la partita.
we can (we cannot) accept lot (of goods)

19. Abbiamo avuto il piacere di ricévere l'avviso
pleasure of receive advice
of receiving
che la consegna è arrivata la settimana scorsa.
consignment (of goods) last (past)

20. Essendo arrivate in buono stato, le partite di
good state
lana hanno fatto una buona impressione sui (= su i)
wool made impression on the
compratori e sono state ben (= bene) presto vendute.
very soon

Exercise 2

Translate into Italian :—

1. We have given the same orders to the men who have left for London.

2. They are tired after the fatigue which they have had (feminine) during the day, and have not been able to work longer (more).

3. We have been in the warehouse and have bought all the goods which (che) we have been able to find at a reasonable price (price reasonable).

4. "To be or not to be" is the question which has been (is been) often in the mouth of many merchants.

5. Do you wish to have the goods to-day or to-morrow, or will you (are you willing to) wait (to wait) still two or three days for the delivery ?

6. The packages have (are) left by the steamer mentioned in the enclosed bill of lading.

7. The long cases have left by (on, = sopra) an Italian vessel directly to Genoa.

8. Being ready (fem. pl.) for the same steamer, we have forwarded the goods without awaiting new instructions.

9. The short pieces are intended (destined) for a buyer who has been here already several times this week.

10. All the coal and charcoal have been shipped in a steamer destined for Naples, which has (is) left the day before yesterday.

11. They say that they are not tired after so much work, but we ourselves are very tired, and we have worked less than they.

12. By (not translated) buying the stocks last week, we have the opportunity of making (to make) this week a very profitable sale (translate, sale very profitable.)

13. These pieces being (translate, being these pieces) too narrow, we must refuse the goods.

14. The letters we have received this morning have brought us (translate, to us have brought) few remittances.

15. We are sorry to have to tell you that we have not yet received (translate, not we have received yet) the lots of wool ordered last year.

16. The impression made (fem. of fatto) on the clients by (da) the good quality of these goods is remarkable.

17. The order for (translate, of) three thousand bags of coffee has (is) arrived, and after being executed we hope to ship (forward) the goods without delay.

18. Why have you not (translate, not have you) executed the order which we have given you ?

19. They left (translate, are left) yesterday evening and returned (are returned) early this morning.

20. I am sorry to say (of to say) that the clients are so tired of these goods that they are not disposed to buy the stocks that we have here. A. C.

SPANISH.—I

THIS course has precisely the same object as the Italian: it aims at instructing the business man who is totally ignorant of the Spanish language in what he will need for commercial purposes. The earnest student of intelligence and application should be able, by studying over a period of, say, twelve to eighteen months, to acquire a working knowledge of commercial Spanish.

As nearly the whole of the writer's life has been passed in the export trade, in Great Britain and in Spanish-speaking countries, the student can be sure that every line of the following course will be of practical business value to him.

Alphabet

a	ah
b	bay
c	thay (as **th** in *think*,
ch	chay
d	day
e	ay
f	èff-ay
g	hay (rough guttural)
h	àh-chay
i	ee
j	hòt-ah (rough guttural)
k	kah
l	èll-ay
ll	èll-yay
m	èmm-ay
n	ènn-ay
ñ	ènn-yay
o	o (nearly as in *or*)
p	pay
q	koo
r	àirr-ay
rr	àirr-ray
s	èss-ay
t	tay
u	oo
v	vay
x	àv-kiss
y	ee gree-àv-gah (or yay)
z	thày-tah (**th** as in *think*)

Vowels.—The vowels are pronounced as follows :—

a	as English	a	in *far*
e	,,	,,	e in *they*
i or **y**	,,	,,	i in *machine*
o	,,	,,	o, almost as in *for*
u	,,	,,	u in *rude*

u is mute in the combinations gue, gui, que, qui, which are respectively pronounced gay, ghee (like English **ge** in *gear*), kay, kee.

Consonants.—**c** before **e** or **i** is pronounced like the Spanish **z**, namely, as **th** in *think*. Otherwise **c** has the sound of **k**.

ch as in *rich*.

d final and in the middle of a word generally approaches the sound of *th* in *this*.

g before e or i is pronounced like the Spanish j, namely as a roughly aspirated **h**, or as ch in the Scotch and German word "loch." In other instances **g** is hard as in *gay*.

h is never heard.

ll is like li in *million*.

ñ is always like ni in *onion*.

r is strongly trilled, and **rr** still more so.

s is always pronounced like ss in *English*, never as z.

x is pronounced as in English.

Stress.—(1) If a word ends in a vowel, a diphthong (**i** or **u** forming one syllable with any other vowel), or **n** or **s**, the emphasis is laid on the last syllable but one.

(2) Words ending in any other consonant have the stress on the last syllable.

Whenever the rules for stress are broken, an acute accent (′) must be placed over the vowel emphasised. This accent is also used to distinguish words of the same spelling but with different meanings. To assist the student in learning to apply correctly the rules for stress, a grave accent (`) is placed over the emphasised vowel of words of more than one syllable in the first few lessons of this work.

Punctuation.—The signs are the same as in English, but it should be noted that the mark of interrogation (?) and exclamation (!) both begin and end the question or exclamation ; the first mark being inverted.

The Article. — The Article has both feminine and masculine forms :—

	Singular			*Plural*	
	Masculine	*Feminine*		*Masculine*	*Feminine*
The	el	la	*the*	los	las
A, an	un	ùna	***some, any***	ùnos	ùnas

Examples :—

Un lìbro, *a book*. El lìbro, *the book*. Ùnos lìbros, *some books*. Los lìbros, *the books*.

Ùna càrta, *a letter*. La càrta, *the letter*. Ùnas càrtas, *some letters*. Las càrtas, *the letters*.

The article agrees in gender and number with the noun, and the latter forms its plural by adding **s** to a vowel and **es** to a consonant or **y**.

El sòcio, *the partner*.	Los sòcios, *the partners*.
El directòr, *the director*.	Los directòres, *the directors*.
La ley, *the law*.	Las lèyes, *the laws*.

With words ending in **z**, the **z** is changed into **c** before adding the plural **es**.

Ùna vez, *once;* dos vèces, *twice;* tres vèces, *three times*, etc.

When a feminine singular noun commences with **a** or **ha**, with the stress on the first syllable, the masculine article is used for the sake of euphony.

El àlza, *the rise (in price, etc.)*—*f.*

but the plural is regular, as :

Las àlzas, *the rises, advances*.

De, *of*, and **á**, *to*, are contracted with **el** into **del**, *of the*, and **al**, *to the*.

Examples :—

Del almacén, *of the warehouse, store, shop*.
Al vapòr, *to the steamer*.

but in the plural :

De los almacènes, *of the warehouses*, etc.
Á los vapòres, *to the steamers*.

The Verb. — There are three conjugations, classified by the first three vowels in the alphabet : **a**, **e**, and **i**, as follows :—

First (or **a**) Conjugation

Infinitive

Compràr — *to buy*.

Present Participle

Compràndo — *buying*.

Past Participle

Compràdo — *bought*.

Second (or **e**) Conjugation

Infinitive

Vendèr — *to sell*.

Present Participle

Vendièndo — *selling*.

Past Participle

Vendìdo — *sold*.

Third (or **i**) Conjugation

Infinitive

Suplìr — *to supply*.

Present Participle

Suplièndo — *supplying*.

Past Participle

Suplìdo — *supplied*.

By adding the terminations shown above, viz :—

1	2	3
-àndo	**-ièndo**	**-ièndo**
-àdo	**-ìdo**	**-ìdo**

to the stem of any regular verb—which stem is obtained by taking off the endings of the infinitive, -àr, -èr, -ìr—the present and past participles are formed.

Examples:—

Aprestàr, *to finish goods, etc.*; aprestàndo, *finishing*; aprestàdo, *finished.*

Temèr, *to fear*; temièndo, temìdo.

Correspondèr, *to correspond*; correspondièndo, correspondìdo.

Aceptàr, *to accept*; aceptàndo, aceptàdo.

Dividìr, *to divide*; dividièndo, dividìdo.

With the past participle of any verb, the auxiliary verb **Habèr** is used to form a compound tense.

The present tense of **Habèr** runs as follows:

Singular	*Plural*
1. He, *I have.*	Hèmos, *we have.*
2.	. . . .
3. Ha, *he has.*	Han, *they have.*
V. ha, *you have (referring to one person).*	Vs. han, *you have (addressing more than one person).*

Note.—V. signifies **Usted** (pl. **Ustedes**), which is a contraction of **Vuestra Merced** (your honour), and therefore takes the same form of the verb as the **third** person.

Examples:—

Hèmos correspondìdo con los clièntes. *We have corresponded with the customers (clients).*

He aceptàdo la lètra. *I have accepted the bill (of exchange).*

Han temìdo esto. *They have feared this.*

Vs. han dividìdo la suma por tres. *You have divided the sum by three.*

V. ha compràdo los géneros. *You have* (i.e., *Your Honour has*) *bought the goods.*

Ha vendìdo las existèncias. *He has sold the stock (stocks).*

¿Ha compràdo V. la tela? *Have you bought the cloth (cotton, linen, etc.)?*

¿Han vendìdo Vs. los paños? *Have you sold the cloth (woollen)?*

It will be seen from the two last examples that in questions V. or Vs. (also all other pronouns, when used) must *follow* the past participle.

The other pronouns are:

Singular	*Plural*
1. yo, *I.*	nosòtros (nosòtras, *f.*), *we.*
2. tú, *thou.*	vosòtros (vosòtras, *f.*), *you.*
3. él, *he*; èlla, *she.*	èllos (èllas, *f.*), *they.*

The second persons **tú** and **vosòtros** (vosòtras) are only used familiarly, and probably will never be required by the student, who should only employ **V.** or **Vs.** in conversation and correspondence, with the third personal form of the verb, for the English pronoun **you.** Where the ending of the verb sufficiently indicates the person, no pronoun is needed.

The full form of the present tense of the verb **Habèr,** including the pronouns and the familiar second person singular and plural, would be:—

Singular	*Plural*
1. yo he.	nosòtros (-as) hèmos.
2. tú has.	vosòtros (-as) habéis.
3. él (èlla, V.) ha.	èllos (èllas, Vs.) han.

VOCABULARY

recibìr, *to receive.*
la máquina, *the machine.*
y, *and.*
mùy, *very.*
ayèr, *yesterday.*
hòy, *to-day.*
mañàna, *to-morrow.*
las tèlas blàncas, *the white goods (cotton textiles, etc.).*
el negociànte, *the merchant.*
pagàr, *to pay.*
contestàr, *to answer.*
señòr, *sir.*
salìr (de), *to go out (of), to leave.*
está compràndo, *he is buying.*
están vendièndo, *they are selling.*
él, *he, him.*
hablàr, *to speak.*
el compradòr, *the buyer.*
no ha compràdo, *he has not bought.*
escribìr, irreg., *to write.*
escrito, *written.*
las zaràzas, *the prints (printed calicoes).*
en, in.
entràr en, *to enter.*
el dinèro, *the money.*
estudiàr, *to study.*
Espàña, Spain.
llegàr, *to arrive.*
ó, *or.*
sí, *yes.*
no, *no, not (always precedes the verb).*
Inglatèrra, *England.*
èntre, *between, among.*
mencionàr, *to mention.*
el prècio, *the price.*
el hermàno, *the brother.*
con, *with.*
mi, *my.*
pèro, *but.*
bièn, *well.*
el abogàdo, *the lawyer, barrister.*

Exercise I

1. ¿Ha llegàdo el directòr? 2. No ha llegàdo. 3. ¿Ha recibìdo V. la càrta? 4. He recibìdo la càrta hòy y ùnos lìbros ayèr. 5. ¿Hèmos aceptàdo las lètras? 6. No las (*them*) hèmos aceptàdo. 7. ¿Han compràdo los negociàntes los géneros? 8. Un directór los (*them*) ha compràdo. 9. ¿Han aprestàdo las tèlas? 10. Las han aprestàdo. 11. ¿Está compràndo el compradòr los pàños? 12. Están comprándolos (verb and pronoun form one word here). 13. ¿Han pagàdo Vs. el àlza? 14. La (*it*—el alza) hèmos pagàdo. 15. ¿Hèmos vendìdo las zaràzas? 16. No las hèmos vendìdo, pèro hèmos vendìdo ùnas máquinas. 17. ¿Ha entràdo V. en el almacén? 18. No, no he entràdo hoy en el almacén. 19. ¿Han hablàdo Vs. con mi hermàno? 20. Salièndo del almacén, hèmos hablàdo con él.

Translate into Spanish:

1. We have written in the books. 2. They have finished (= put a finish on) the goods yesterday. 3. Have you corresponded once with the customers? 4. We have written twice or three times to the clients. 5. Have you written to the merchant's partner (partner of the merchant)? 6. No, sir, but I have written to the merchant's buyer. 7. Are the white goods well finished (aprestàdas)? 8. The white goods are very well finished. 9. Dividing the money among the partners. 10. The lawyers have studied the laws of England. 11. The steamers have arrived yesterday. 12. Some goods have arrived from Spain. 13. Buying some stocks in the warehouse. 14. Selling the goods at the price mentioned. 15. Have you spoken with him to-day? 16. Yes, sir, but he has not answered. 17. Leaving the warehouse to-day or to-morrow. 18. We have feared this. 19. Have they bought the cloth (cotton, etc.)? 20. They have bought the cloth (woollen) and sold the machines.

A. C.

Continued from page 228.

GEOGRAPHY:

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AFRICA.—I

AFRICA is a senior continent. Its soil ranks among the oldest in the world; that is to say, the earth which forms the continent has remained unsubmerged for a longer period than that of any other. The continent of Africa has in all probability possessed a land connection with Europe ever since the territories of the earth began to assume something approaching their present shape.

The African Continent, including Madagascar, has an area of 11,498,000 square miles, and is thus of considerably less extent than Asia, which covers 17,256,000 square miles. From the physical point of view it can claim very few, if any, of the world's records. Its loftiest mountains are situated in the central east, but the highest of these just fails to reach an altitude of 20,000 feet, and thus cannot rival the altitudes of the peaks of the Himalaya and Andes. Lake Victoria Nyanza is an important sheet of water, having an area of over 26,000 square miles, and an altitude of 3,700 feet.

Rivers and—

Africa possesses four important rivers; the Nile, Niger, Congo, and Zambezi. But even these great streams would appear insignificant by the side of half a dozen of the rivers of the New World. These African rivers, moreover, magnificent though their scenery frequently is, are apt to prove disappointing for navigation, owing to the numerous sets of rapids with which their waters are beset. So far as steamers are concerned, the great majority of the river mouths are obstructed by bars which render their navigation difficult.

In order to enter into some details concerning the physical characteristics of the continent, we may first of all deal with the mountains. On the north, the Atlas Mountains form the main feature of this kind. Drawn boldly across the northernmost coastline of Africa, they attain in Morocco to heights of over 15,000 feet, and the range presents a magnificent spectacle, its summits being snow-crowned all the year round.

There are mountains of considerable altitude in the Sahara, the principal ranges here being those of the Tibesti and the Ahaggar. It is probable that there are points in both these ranges which fall very little short of 9,000 feet.

—Mountains

The western lands of Africa are, on the whole, of a much less mountainous nature than those on the east. There are, nevertheless, some notable peaks to be met with here and there. The loftiest of these is a snow-covered volcano in the Cameroons, known as the Mongo ma Loba, or the Mountain of God, which rises to an altitude of about 13,300 feet.

The remaining mountains of West Africa rise on the frontier between Liberia and French West Africa, attaining to a height of about 6,000 feet; in Eastern Nigeria, where the principal altitude exceeds this by a couple of thousand feet; and in Angola, where the topmost peaks are of much the same altitude.

We may now turn to the eastern half of the continent. Practically the entire coast of the Red Sea is mountainous, some of the ranges rising to 6,000 feet. To the south of this the mountains of Abyssinia and Gallaland are among the most striking in the whole of Africa, rising to about 16,000 feet in altitude, and thus dwarfing the 9,000 feet or so to which some of the ranges of the British south-eastern Sudan attain.

The Elgon Volcano (15,000 feet) is situated in the Uganda Protectorate. Quite near it is the splendid dome of Kilimanjaro, the highest mountain in Africa, a volcano, falling short by only a hundred yards of 20,000 feet. Near this again is the volcano of Kenia, which exceeds 17,000 feet in height. Another very famous range is that of the Mountains of the Moon. These peaks are probably the most imposing of all in the

Africa is the senior continent; that is to say, the soil which forms it has remained unsubmerged for a longer period than that of any other.

continent, although in actual altitude their highest point falls a little below the volcano of Kenia.

Just to the north of Lake Nyasa the highest point is Mount Rungwe (10,000 feet), while Mlanje in Nyasaland is about 300 feet lower. On the borders of Rhodesia and Portuguese East Africa is a range which culminates to the south in the splendid peaks of the famous Drakensberg in Natal and Basutoland, some 11,000 feet. To the south of this again are the mountains of Cape Colony, the highest points of which attain to an altitude of some 6,000 feet.

Great Lakes

With the exception of Lake Chad, just to the south of the Sahara Desert, the great lakes of the continent are situated in the east and south-east. The largest of these is Victoria Nyanza, which has a surface area of over 26,000 square miles. The next in size is Tanganyika (12,000 square miles), the third being Nyasa, the surface area of which is rather less than 12,000 square miles. Next in order comes Lake Chad, but the 5,000 square miles which its surface covers are largely rendered useless for practical purposes by the shallowness of its waters. The remaining important lakes are : Bangweulu, 2,500 square miles ; Leopold, 2,000 square miles ; and Mweru, 1,800 square miles.

It has already been said that the four great river basins of Africa are those of the Nile, Congo, Niger, and Zambezi. Some rivers of less importance are the Shari and Logun, both of which flow into Lake Chad ; the Senegal, Voltas, Kwanza, and Kunene on the west, and the Juba, Rufiji, and Ruvuma on the east. The chief rivers of the south are the Orange, Limpopo, and Sabi.

The African coast line is remarkable for its compact form and for the regularity of its outline. The only other continent which approaches it in this respect is South America; but in the case of this latter, although the general outline of the coast may appear almost similarly compact at the first glance, a large scale map will show a very much greater number of indentations.

The climate of Africa is much what would be expected from a continent which, having its centre in the tropics, may be said to sit astride the equator. Owing to this situation it is generally held to possess the hottest climate in the world, but it would be more accurate to say that in comparison with its bulk a larger area of its territories lies within the hot zone than that of any other continent. The districts where the greatest heat prevails, as a matter of fact, are not those directly under the equator, but rather those to the north and south of the line, nearer the respective neighbourhoods of the tropics of Cancer and Capricorn.

Before entering into the details of the African climate the main fact should be remembered that the rainy zone proper of the continent is in its centre. The climates of the north and of the south are both dry, but in rather widely differing degrees. Thus, whereas the climate of the south—with the exception, of course, of the waterless Kalahari Desert—is merely dry in the sense that the European coast of the Mediterranean is termed dry, brilliant sunshine prevailing between the periodical rains, the weather conditions of the north are very different.

Egypt and the Sahara Desert are practically rainless, and, although this phenomenon does not occur on the African coast itself bordering the Mediterranean, the rainfall even here is, on the whole, less than the average prevailing in South Africa.

The Sahara Desert

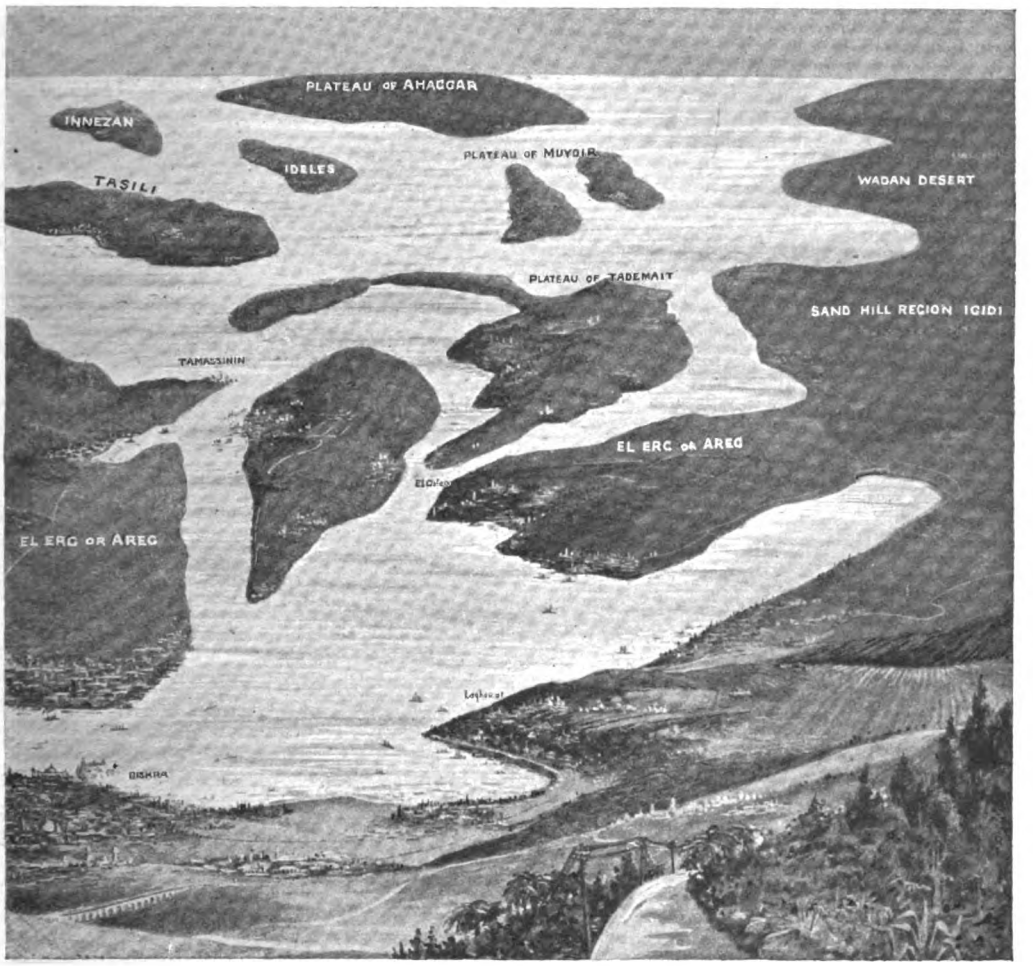
So dry, indeed, is the Sirocco wind that blows across the Sahara that it is responsible for a curious phenomenon in the island of Madeira, some 400 miles distant from the coast. When this wind prevails its desiccating power is such that even after its passage across so many miles of ocean it causes paper and similar objects in the island to curl up, and under its influence old timber has frequently been observed to split apart.

From time to time various irrigation schemes have been brought forward—mainly by French engineers—for flooding the Sahara desert, and so rendering fertile large tracts of lofty but otherwise barren land. Savants have raised many objections to the scheme. But even if it did not—as some have asserted it would—change the axis of the earth and give England an arctic climate—it is equally doubtful if it would fulfil the old Hebrew prophecy concerning the day "when the parched ground shall become a pool" and "the desert shall blossom as the rose."

Tropical Africa is frequently visited by thunderstorms of extreme violence, these atmospheric disturbances being characteristic of the Equatorial latitudes. The climate of the forest coastal belt is more trying to the white man than any other in the continent. Apart from the fevers that lurk in its low-lying, leafy realms, a peculiarity which the Europeans who visit this country

find exceptionally distressing is the monotony of the atmosphere. As this is hot and humid all the year round, its enervating effect upon strangers is very soon noticeable. There are very few of these, indeed, who do not soon discover how well-founded is the evil reputation of this coast.

A disease which would appear to be peculiar to the African tropics is the sleeping sickness. This is of two types—the Congo and the Rhodesian. The Congo type prevails almost throughout the Belgian and French Congo, and takes in a large part of the northern half of Portuguese West Africa.



IF THE SAHARA WERE FLOODED.

Showing what would happen if the waters of the Mediterranean were let into the desert and the scheme put forward by French engineers of fertilising the high parts of the desert by flooding the low were carried into effect.

In passing we may remark on some of those tropical diseases for which many portions of Equatorial Africa are unpleasantly notorious. The range of the malarial and blackwater fevers is the greatest of all. These diseases begin to be met with to the south of the Sahara Desert, in the countries where the healthy, barren sand has given way to tropical verdure, and, perhaps, steaming swamps.

The Rhodesian type of sleeping sickness infests a far smaller area, and would seem to be confined to the territories of Northern Rhodesia to the west of Lake Nyasa, and to a small neighbouring area of the Belgian Congo.

Africa, it is said—and there is little doubt that it is an historical fact—was circumnavigated by the Phœnicians some thousands of years before the Portuguese sailors drove

the cumbrous bows of their vessels round that southernmost point—a cape which raised their anticipations to a pitch, fully justified by the later circumstances, that caused them to name it the Cape of Good Hope. The Portuguese circumnavigated the continent from west to east, but the Phœnicians, starting from the Red Sea, made their voyage from the other side, which occupied more than two years!

In this case we may begin with the Mediterranean harbours of Alexandria and Port Said on the northern coast of Egypt. Both of these harbours afford efficient anchorages, but this has been brought about by artificial means. Suez, at the southern extremity of the canal which unites the Mediterranean with the Red Sea, is a port of the same nature, and the same is true of Port Sudan, the comparatively new British port on the shores of the Red Sea. The Italian port of Massawa, on the same coast, comes next in order, and to the south of this again is the French port of Jibuti, situated at the southern entrance of the Red Sea, almost opposite to Aden on the coast of Asia.

East Coast Anchorages

The next port, the British one of Berbera, is important from a strategic and commercial point of view. Turning the easternmost point of Italian Somaliland, and proceeding now to the south-west along the shores of the Indian Ocean, it is somewhat remarkable that no good harbour is met with until the equator has been passed, and the port of Mombasa has been reached. In this the British possess a magnificent harbour. This is rivalled farther south by Dar-es-salaam, which is situated opposite Zanzibar. Another fine natural anchorage is Tunghi Bay, on the frontiers of Portuguese East Africa.

So far as the east coast of Africa is concerned, it is in the tropical districts to the south of the equator that the finest collection of anchorages is found; beyond those already mentioned, the Mozambique coast contains those of Ibo, Pemba, Memba, Fernao Veloso, Mozambique, and Angoza. South of this again, and still in Portuguese territory, is Quilimane, Chinde, and Beira, an important port; Inhambane, an anchorage of less consequence, and Delagoa Bay.

Passing down the coast of British South Africa, we have the port of Durban as the outlet of the flourishing colony of Natal. The next place of importance is Port Elizabeth in Cape Colony. This is a fine harbour, but is outdone in the way of an anchorage by the harbours on the west and east of the Cape Peninsula, these being Table Bay and False Bay respectively. It is on the shores of the former, of course, that is situated Cape Town.

We have now rounded the southernmost point of the continent, and, leaving behind the region of heavy seas and great rollers, we proceed N.N.W. to Saldanha Bay.

None of the harbours on this stretch of coast calls for any particular attention from the point of view of natural advantages. Arriving at the coast of the Protectorate of South West Africa, the port next in order is Angra Pequena, and then, proceeding still to the north, just within the Tropic of Capricorn lies Walfish Bay. On the southern coast of the Portuguese West African Colony of Angola is the port of Mossamedes. Lobito Bay comes next, just to the north of the town of Benguela. Loanda, the northern port of Loanda, is sufficiently well situated, but its tendency is to silt up.

Harbours on the West

Boma, on the Congo River, the capital of the Belgian Congo, serves as the outlet of the produce of its great hinterland. To the north of this are various anchorages, none of them of any particular natural merit. It is not until the British Nigerian port of Old Calabar is reached that a really fine harbour presents itself. After Port Harcourt, situated on one of a collection of inlets to the east of the mouth of the Niger River, comes the better known Nigerian port of Lagos, which, for all its commercial importance, has little to boast of in the way of natural anchorage.

On the western trend of the coast which succeeds this the natural harbours are of minor importance. The harbour of Sierra Leone, on the other hand, is not only picturesquely situated, but offers a fine anchorage. The entrance to the Gambia River, too, is deep and sheltered, and the port of Bathurst, situated on its bank, is thus very favourably placed.

The port of Dakar has been made into a good harbour by the French.

The north-eastern sloping shoulder of the continent has no efficient anchorage to show until Tangier is reached. The African coast of the Mediterranean is for the most part sandy.

The chief harbours of the first stretch of this coast are Ceuta, Melilla, Oran, Algiers, and Tunis. Tripoli and Benghazi are situated between this last port and Alexandria.

W. H. K.

Continued from page 237.

MATHEMATICS:

Contributor: — ARITHMETIC, ALGEBRA, GEOMETRY, CO-ORDINATE GEOMETRY, TRIGONOMETRY, MECHANICS, MENSURATION, ETC.

(M. A. Lewenz, M.A.[Lond.]).

ALGEBRA.—XXVIII

160. Applications of the Binomial Theorem.

(1) Find $\sqrt[3]{29}$ to 4 places of decimals.

$$\sqrt[3]{29} = \sqrt[3]{27+2} = (27+2)^{\frac{1}{3}} = \left\{27\left(1+\frac{2}{27}\right)\right\}^{\frac{1}{3}}$$

$$= 3\left(1+\frac{2}{27}\right)^{\frac{1}{3}} = 3\left(1+\frac{1}{3}\cdot\frac{2}{27}+\frac{\frac{1}{3}\left(-\frac{2}{3}\right)}{1\,.\,2}\cdot\frac{2^2}{27^2}\right.$$

$$+\frac{\frac{1}{3}\left(-\frac{2}{3}\right)\left(-\frac{5}{3}\right)}{1\,.\,2\,.\,3}\cdot\frac{2^3}{27^3}$$

$$\left.+\frac{\frac{1}{3}\left(-\frac{2}{3}\right)\left(-\frac{5}{3}\right)\left(-\frac{8}{3}\right)}{1\,.\,2\,.\,3\,.\,4\,.}\cdot\frac{2^4}{27^4}+\ldots\ldots\right)$$

$T_1 = 3$; $T_2 = T_1 \times \frac{2}{81} = \cdot074{,}074$; $T_3 = T_2 \times \frac{-2}{81} = -\cdot001{,}829$; $T_4 = T_3 \times \frac{-5}{9} \times \frac{2}{27} = \cdot000{,}075$; $T_5 = T_4 \times \frac{-2}{3} \times \frac{2}{27} = -\cdot000004$.

The terms are diminishing and we see that T_6 will be a decimal beginning with more than 5 ciphers, and as we only want 4 places of decimals we need go no further.

$\therefore \sqrt[3]{29} = 3 + \cdot074074 - \cdot001829 + \cdot000075 - \cdot000004 = 3\cdot072316 = 3\cdot0723$ to 4 places of decimals.

(2) If x be so small that its square and higher powers may be neglected find the value of $(1-7x)^{\frac{1}{3}} \times (1+2x)^{-\frac{3}{4}}$. Since x^2 and higher powers may be neglected, it will be sufficient to retain 2 terms of each binomial.

$$(1-7x)^{\frac{1}{3}}(1+2x)^{-\frac{3}{4}} = \left(1-\frac{7}{3}x\right)\left(1-\frac{3}{4}\cdot 2x\right)$$

$$= \left(1-\frac{7}{3}x\right)\left(1-\frac{3}{2}x\right) = 1-\frac{23}{6}x$$ (neglecting the term involving x^2).

161. Coefficients. To find the sum of the 1st $(r+1)$ coefficients in $(1-x)^n$.

$$(1-x)^n = 1 - \frac{n_1}{1}x + \frac{n_2}{2!}x^2 + \ldots + (-1)^r\frac{n_r}{r!}x^r + \ldots$$

$$(1-x)^{-1} = 1 + x + x^2 + x^3 + \ldots + x^r + \ldots$$

Now the coefficient of x^r in the product of the two series = coefficient of x^r in $(1-x)^n \times (1-x)^{-1}$ i.e. in $(1-x)^{n-1}$.

$$\therefore 1 - \frac{n_1}{1} + \frac{n_2}{2!} - \frac{n_3}{3!} + \ldots + (-1)^r\frac{n_r}{r!}$$

= coefficient of x^r in $(1-x)^{n-1}$,

$$= (-1)^r\frac{(n-1)_r}{r!} = (-1)^r\frac{(n-1)!}{r!\,(n-r-1)!}$$

Example:—

Find the sum of the first r coefficients in the expansion of $(1-x)^{-5}$.

The sum is the coefficient of x^{r-1} in $(1-x)^{-6}$

$$= \frac{6\,.\,7\,.\,8\,.\,.\,.\,(r+3)(r+4)}{(r-1)!}$$

$$= \frac{1\,.\,2\,.\,3\,.\,4\,.\,5\,.\,6\,.\,7\,.\,.\,.\,(r+3)(r+4)}{1\,.\,2\,.\,3\,.\,4\,.\,5\,.\,(r-1)!}$$

$$= \frac{1}{120}r(r+1)(r+2)(r+3)(r+4).$$

162. Many series are derived from the Binomial, and by means of it we can often find their sum.

We must remember that the index is negative, that $(1-x)^{-n}$ has all its terms positive.

and that $(1-x)^{-n} = 1 + nx + \frac{n(n+1)}{2!}x^2 + \ldots + \frac{n(n+1)\ldots(n+r-1)}{r!}x^r + \ldots$

and this may be written

$$\frac{1}{(n-1)!}\left[1\,.\,2\,.\,3\,.\,.\,.(n-1) + (2\,.\,3\,.\,4\,.\,.\,.\,n)x + \{3\,.\,4\,.\,5\,.\,.\,.\,.\,n(n+1)\}x^2 + \ldots + \{(r+1)(r+2)\ldots(r+n-1)\}x^r + \ldots\right]$$ A.

And when the index is negative and fractional, say $-\frac{l}{m}$, we have $(1 \pm x)^{-\frac{l}{m}} = 1 \mp \frac{l\,.\,x}{1\,.\,m} + \frac{l(l+m)}{2!}\left(\frac{x}{m}\right)^2 \mp \frac{l(l+m)(l+2m)}{3!}\left(\frac{x}{m}\right)^3 + \ldots\ldots$ B.

This is written in the form of a series in which the additional factors in successive numerators are in A. P. and their common difference is the denominator of the index and that in the successive denominators the additional factors are 1 . 2 . 3 . 4 . . . . or multiples of these.

Examples:—

(1) Find the value of $1 + \frac{1}{1!}\frac{3}{2^3} + \frac{1\,.\,3}{2!}\frac{3^2}{2^6} + \frac{1\,.\,3\,.\,5}{3!}\cdot\frac{3^3}{2^9} + \ldots\ldots = S.$

$$S = 1 + \frac{\frac{1}{2}}{1!}\cdot\frac{3}{2^2} + \frac{\frac{1}{2}\cdot\frac{3}{2}}{2!}\cdot\frac{3^2}{2^4} + \frac{\frac{1}{2}\cdot\frac{3}{2}\cdot\frac{5}{2}}{3!}\cdot\frac{3^3}{2^6} + \ldots\ldots$$

$$= \left(1 - \frac{3}{2^2}\right)^{-\frac{1}{2}} = \left(\frac{1}{4}\right)^{-\frac{1}{2}} = \frac{1}{\sqrt{\frac{1}{4}}} = 2.$$

(2) Find the value of $\frac{3}{2\cdot 4} + \frac{3\cdot 4}{2\cdot 4\cdot 6} + \frac{3\cdot 4\cdot 5}{2\cdot 4\cdot 6\cdot 8} + \ldots\ldots$ S.

Here the factors of the denominator are multiples of 1 . 2, 3, 4 . . . . but they do not begin at the beginning. We must ∴ add some terms and also add some factors to the existing terms in order to get the series into the form of a binomial. The factors of the 1st denominator may be written $2!\ 4 = 2!\ (2)^2$. But with 2! in the denominator, we need two factors in the numerator, and ∵ the common difference of the factors in the numerator is 1, and the existing numerator is 3, we add the factor 3 − 1 = 2. The term thus altered would be the third in a binomial series ∴ we must add the 1st and second terms, viz. $1 + 2 \times \frac{1}{2}$.

These 3 terms are the first three in the expansion of $\left(1 - \frac{1}{2}\right)^{-2}$ (*see* § 162).

Hence we have

$$\left(1 - \frac{1}{2}\right)^{-2} = 1 + 2\left(\frac{1}{2}\right) + \frac{2\cdot 3}{2!}\left(\frac{1}{2}\right)^2 + \frac{2\cdot 3\cdot 4}{3!}\left(\frac{1}{2}\right)^3 + \frac{2\cdot 3\cdot 4\cdot 5}{4!}\left(\frac{1}{2}\right)^4 + \ldots\ldots$$

$$= 1 + 2\left(\frac{1}{2}\right) + 2\left\{\frac{3}{2\cdot 4} + \frac{3\cdot 4}{2\cdot 4\cdot 6} + \frac{3\cdot 4\cdot 5}{2\cdot 4\cdot 6\cdot 8} + \ldots\ldots\right\}$$

$$\therefore \left(1 - \frac{1}{2}\right)^{-2} = 1 + 2 \times \frac{1}{2} + 2S$$

$$\therefore 2S = \left(1 - \frac{1}{2}\right)^{-2} - 1 - 1 = 4 - 2 = 2 \quad \therefore S = 1$$

163. Exponential Theorem.

To find the value of $f(m) = 1 + m + \frac{m^2}{2!} + \frac{m^3}{3!} + \ldots + \frac{m^r}{r!} + \ldots$ (i)

we proved in § 154 that this series is convergent for all finite values of m.

Let $f(s) = 1 + s + \frac{s^2}{2!} + \frac{s^3}{3!} + \ldots + \frac{s^r}{r!} + \ldots$ (ii).

∵ both are absolutely convergent we may multiply them; then $f(m) \times f(s) = 1 + (m + s) + \left(1 \cdot \frac{m^2}{2!} + s \cdot m + \frac{s^2}{2!}\cdot 1\right) + \left(1 \cdot \frac{m^3}{3!} + \frac{sm^2}{2!} + \frac{s^2 m}{2!} + \frac{s^3}{3!}\cdot 1\right) + \ldots + \left(1\,\frac{m^r}{r!} + \frac{sm^{r-1}}{(r-1)!} + \frac{s^2}{2!}\cdot\frac{m^{r-2}}{(r-2)!} + \cdots \frac{s^t}{t!}\cdot\frac{m^{r-t}}{(r-t)!} + \ldots + \frac{s^r}{r!}\cdot 1\right) + \ldots$

Consider the terms of r dimensions; they

$$= \frac{1}{r!}\left[m^r + \frac{r!}{1!(r-1)!}s\cdot m^{r-1} + \frac{r!}{2!(r-2)!}s^2 m^{r-2} + \ldots + \frac{r!}{t!(r-t)!}s^t m^{r-t} + \ldots + s^r\right]$$

$$= \frac{(m+s)^r}{r!}.$$

$$\therefore f(m) \times f(s) = 1 + \frac{(m+s)}{1} + \frac{(m+s)^2}{2!} + \frac{(m+s)^3}{3!} + \ldots + \frac{(m+s)^r}{r!} + \ldots$$

$$\therefore f(m) \times f(s) = f(m + s) \quad \text{(iii)}.$$

Here we have $f(0) = 1$ (iv)

and $f(1) = 1 + 1 + \frac{1}{2!} + \frac{1}{3!} + \ldots + \frac{1}{r!} + \ldots = e$ (v).

∵ (i) is convergent for all finite values of m ∴ (v) is convergent.

If m is a positive integer, then

$f(1) \times f(1) = f(1 + 1) = f(2)$ and similarly $f(1) \times f(1) \times f(1) \ldots$ to m factors $= f(m)$

$\therefore f(m) = \{f(1)\}^m = e^m$ where e is the symbol employed for $f(1)$.

If m is a positive fraction, let $m = \frac{r}{s}$ where r and s are positive integers.

Then $f\left(\frac{r}{s}\right) \times f\left(\frac{r}{s}\right) \times f\left(\frac{r}{s}\right) \ldots$ to s factors

$= f\left(\frac{r}{s} + \frac{r}{s} + \frac{r}{s} + \ldots \text{ to } s \text{ terms}\right) = f(r) = e^r$

$\therefore f\left(\frac{r}{s}\right)$ is an sth root of $e^r = e^{\frac{r}{s}}$

$\therefore f(m) = e^m$ when $m = \frac{r}{s}$ i.e. $f(m) = e^m$ for all positive values of m.

If m is negative,

then $f(m) \times f(-m) = f(0) = 1$

$\therefore f(m) = \frac{1}{f(-m)}$. Now $-m$ is positive

$\therefore f(-m) = e^{-m} \quad \therefore \frac{1}{f(-m)} = \frac{1}{e^{-m}} = e^m$

$\therefore f(m) = e^m$.

Thus we have proved that $f(m) = e^m$ for all commensurable values of m, positive or negative.

i.e. $e^m = 1 + m + \frac{m^2}{2!} + \ldots + \frac{m^r}{r!} + \ldots$ (vi).

The student should calculate the value of e from (v). He will find that $e = 2{\cdot}7182818$ correct to 7 places of decimals.

Exercise 38

Find to 4 places of decimals

(1) $\sqrt{98}$. (2) $\sqrt[3]{1003}$. (3) $\sqrt[5]{3128}$.

If x be so small that its square and higher powers may be neglected find the value of

(4) $\frac{\sqrt{4 - x}}{\left(3 - \frac{x}{2}\right)}$. (5) $\frac{(1 - 3x)^{-\frac{2}{3}} + (1 - 4x)^{-\frac{3}{4}}}{(1 - 3x)^{-\frac{1}{3}} + (1 - 4x)^{-\frac{1}{4}}}$.

(6) Find the sum of the first r coefficients in the expansion of $(1 - x)^{-3}$.

Find the value of the following series :—

(7) $1 - \frac{1}{2}\cdot\frac{1}{2} + \frac{1\cdot 3}{2\cdot 4}\cdot\frac{1}{2^2} + \frac{1\cdot 3\cdot 5}{2\cdot 4\cdot 6}\cdot\frac{1}{2^3} + \ldots\ldots$

(8) $\frac{3}{4} + \frac{3\cdot 5}{4\cdot 8} + \frac{3\cdot 5\cdot 8}{4\cdot 8\cdot 12} + \ldots\ldots$

(9) $2 + \frac{5}{2!3} + \frac{5\cdot 7}{3!3^2} + \frac{5\cdot 7\cdot 9}{4!3^3} + \ldots\ldots$

Key to Exercise 37

(1) $\frac{1}{2}(r+1)(r+2)x^r$.

(2) $(-1)^r \frac{2 \cdot 5 \cdot 8 \ldots (3r-1)}{3 \cdot 6 \cdot 9 \ldots 3r} x^r$.

(3) $(-1)^{r-1} \frac{2 \cdot 1 \cdot 4 \cdot 7 \cdot 10 \ldots (3r-5)}{3 \cdot 6 \cdot 9 \ldots 3r} x^r$.

(4) $\frac{3 \cdot 8 \cdot 13 \ldots (5r-2)}{r!} x^r$.

(5) $-\frac{5 \cdot 3 \cdot 1 \cdot 3 \cdot 5 \ldots (2r-7)}{r!} x^r a^{5-r}$ when $r > 3$.

M. A. L.

MECHANICS.—V

29. Combination of a uniform velocity with a velocity uniformly accelerated in a constant direction.—Suppose a body starts from A with a uniform velocity v in the direction A X and a uniform acceleration a in the direction A Y. Then in successive seconds the distance travelled in

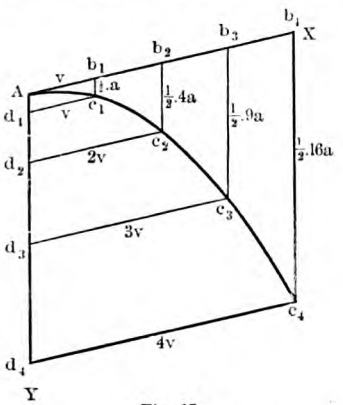


Fig. 17.

the direction A X will be v, $2v$, $3v$, $4v$, so that if this constant velocity alone were possessed by the body it would be at b_1 after 1 sec., at b_2 after 2 sec., at b_3 after 3, at b_4 after 4 and so on.

The distance travelled in successive seconds owing to the acceleration in the direction A Y is (since $s = \frac{1}{2}at^2$) $\frac{1}{2}a$, $\frac{1}{2} \cdot 4a$, $\frac{1}{2} \cdot 9a$, $\frac{1}{2} \cdot 16a$, so that if the acceleration alone were possessed by the body it would in successive seconds be at d_1, d_2, d_3, d_4.

The actual position at the end of any second is found by completing the parallelograms $Ab_1c_1d_1$, $Ab_2c_2d_2$ and so on. Thus the body is actually in the positions, c_1, c_2, c_3, c_4 after 1, 2, 3 and 4 seconds. The simplest continuous curve which passes through these points is a parabola, and this is the actual path of the body. It is the path of a projectile, if we neglect the resistance of the air, the acceleration being due to gravity.

30. We have already dealt with falling bodies, and with such as are projected vertically upwards or downwards. We will now consider bodies projected horizontally or in a direction inclined to the vertical.

To determine the motion of a body projected horizontally.

(We shall in the following neglect the friction of the air.)

Suppose a body is projected from a cliff of height h, with a horizontal velocity v. It will have an acceleration g, vertically downwards, due to gravity. The position of the body at any moment may be found by a diagram similar to that in the preceding paragraph (Fig. 18).

It will reach the ground when the space traversed due to the acceleration g is equal to h.

Now $h = \frac{1}{2}gt^2 \therefore t = \sqrt{\frac{2h}{g}}$

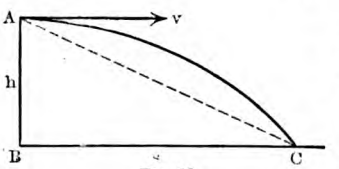


Fig. 18.

The point C at which it strikes the ground is at a distance B C $= s$ from the foot of the cliff.

s = space traversed due to horizontal velocity v

i.e. $s = vt = v\sqrt{\frac{2h}{g}}$.

This horizontal distance is usually called the *range*.

Putting in for g the value 32 $\frac{\text{ft.}}{\text{sec.}^2}$, we have

$t = \frac{1}{4}\sqrt{h}$ and $s = \frac{1}{4}v\sqrt{h}$.

Next suppose the body to be projected in a direction inclined to the vertical (Fig. 19).

If A O be the direction in which the body is projected with a uniform velocity v. Then by drawing the accompanying diagram, in which $Ab_1 = v$; $Ab_2 = 2v$; $Ab_3 = 3v$ and dropping the verticals b_1c_1, b_2c_2, b_3c_3, etc., where b_1c_1, b_2c_2, b_3c_3 equal in length the distances through which the body would fall freely in 1, 2 and 3 seconds respectively, we find the points c_1, c_2, c_3 on its path.

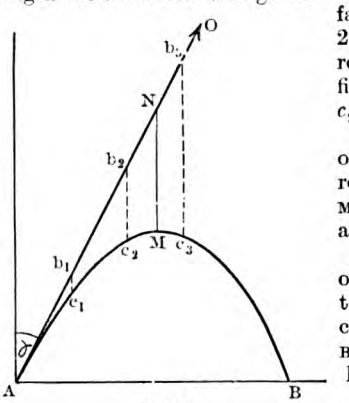


Fig. 19.

If after t seconds the body reaches the point M, then A N $= vt$ and N M $= \frac{1}{2}gt^2$.

After the lapse of a certain time the body will come to a point B in a horizontal line with A.

A B is called the **horizontal range**, and the time taken to reach B is called the **whole time of flight.**

To find the whole time of flight, the horizontal range and the height to which the body rises.

We must resolve v into its vertical and horizontal components.

Let the vertical component be u, and the horizontal component be v.

Then u will be lessened by g as the body rises until the highest point is reached, and then u will be increased by g as the body falls.

If t be the time taken to reach the highest point then $u = gt \therefore t = \frac{u}{g}$.

Then the whole time of flight $= 2t = \frac{2u}{g}$.

If h be the height to which the body rises

$u^2 = 2gh \therefore h = \frac{u^2}{2g}$.

Since v is the horizontal velocity, and the time taken to go from A to B is $2t = \frac{2u}{g}$

$\therefore$ A B = horizontal range $= v \times \frac{2u}{g} = \frac{2uv}{g}$.

In most cases the velocity v can only be resolved into its horizontal and vertical components with the aid of trigonometry.

Examples :—

(1) A ball is projected horizontally from the top of a cliff 49 feet high with a velocity of 100 $\frac{\text{ft.}}{\text{sec.}}$. Find at what distance from the tower it will strike the ground.

Let t = time taken and s the length of the range

$t = \sqrt{\frac{2h}{g}} = \sqrt{\frac{2 \times 49}{32}} = \frac{7}{4}$ sec.

$s = vt = 100 \times \frac{7}{4}$ ft. $= 175$ ft.

(2) A stone is dropped from the car of a balloon travelling horizontally with a speed of 40 $\frac{\text{ft.}}{\text{sec.}}$ at a height of 400 ft. above the ground. Find when, where and with what velocity the stone will strike the ground.

The time taken t = time required to fall 400 ft.

$400 = \frac{1}{2} gt^2 \therefore t^2 = \frac{2 \times 400}{32} = 25 \therefore t = 5$ sec.

vertical velocity u acquired in 5 sec. $= 5 \times 32 = 160 \frac{\text{ft.}}{\text{sec.}}$

horizontal velocity $v = 40 \frac{\text{ft.}}{\text{sec.}} \therefore$ horizontal distance travelled $= vt = 40 \times 5 = 200$ ft.

Hence the stone will fall at a pt. 200 ft. away from the spot it would have struck had the balloon been stationary. It will have a horizontal vel. of 40 $\frac{\text{ft.}}{\text{sec.}}$ and a vertical vel. of 160 $\frac{\text{ft.}}{\text{sec.}}$.

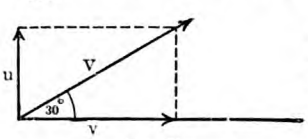


Fig. 20.

(3) A cannon ball is projected at an angle of 30° to the horizon with a velocity of 2,000 $\frac{\text{ft.}}{\text{sec.}}$. Find its range and the greatest height to which it will rise.

Resolving the velocity v at an angle of 30° to the horizon into its vertical and horizontal components u and v, we find

$u = \frac{1}{2} \text{v} = \frac{1}{2} \times 2{,}000 \frac{\text{ft.}}{\text{sec.}} = 1{,}000 \frac{\text{ft.}}{\text{sec.}}$

$v = \frac{\sqrt{3}}{2} \text{v} = 1{,}000 \cdot \sqrt{3} \frac{\text{ft.}}{\text{sec.}}$

h, the height to which it will rise $= \frac{u^2}{2g} = \frac{1{,}000^2}{64}$ $= 15{,}625$ ft.

s = horizontal range $= \frac{2uv}{g} = \frac{2 \times 1{,}000^2 \times \sqrt{3}}{32}$ ft. $= 20{\cdot}5$ miles approximately.

Motion on an inclined plane.

To find the actual acceleration with which a body moves if it slides down, or is projected up, a smooth inclined plane.

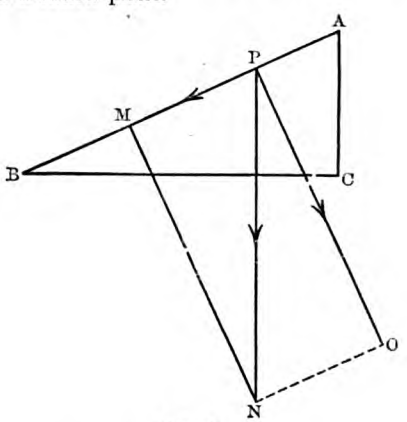


Fig. 21.

Let A B C be a smooth inclined plane making an angle A B C with the horizon.

Suppose the body is at P.

Draw P N vertically downwards, make P N = A B and let P N represent the acceleration g with which the body would move vertically downwards if it were falling freely. Draw N M at right angles to A B, then the triangle P N M equals the triangle A B C in all respects and P M represents the resolved part of the acceleration P N in the direction A B.

Now let this component of the acceleration be a

then $\frac{a}{g} = \frac{\text{P M}}{\text{P N}} = \frac{\text{A C}}{\text{A B}} \therefore a = \frac{\text{A C}}{\text{A B}} \cdot g$.

If we call A C the height of the plane h and A B the length of the plane l

then $a = \frac{h}{l} g$.

If the body be projected up the plane, it will have a negative acceleration, or retardation $= \frac{-h}{l} g$.

Examples :—

(1) Find the velocity with which a body must be projected up an inclined plane of height h and length l, so that it just reaches the top.

Let v_0 be this initial velocity.

At the top v will be equal to zero.

Now $2as = v^2 - v_0^2$

$\therefore 2 \times \left(-\frac{h}{l}\right) \cdot g \cdot l = 0 - v_0^2$

$\therefore v_0^2 = 2gh \therefore v_0 = \sqrt{2gh}$.

(2) Find the velocity of a body that has fallen

for 3 seconds down a plane that rises 2 inches in a length of 5 inches.

$v = v_0 + at$. Here $v_0 = 0$ since the body falls from rest. $\therefore\ v = at = \frac{h}{l}gt = \frac{2}{5} \times 32 \times 3 \frac{\text{ft.}}{\text{sec.}}$

$= 38{\cdot}4 \frac{\text{ft.}}{\text{sec.}}$.

31. This practically concludes what we have to say on Kinematics, though we may touch upon other points later on.

Before starting on the second part of our subject, Dynamics, we will say a few words on the different systems of measurement, and will add a table of the important formulæ we have proved so far.

The **foot-pound-second,** or **F. P. S.,** system of measurement is the English system.

The unit of length is a foot, the unit of time is one second and the unit of mass is the pound avoirdupois.

The standard of length, 1 ft., is one-third of a **yard,** and a yard is the distance between two marks on a bar of metal at 62° Fahrenheit, this bar being kept at the exchequer offices.

The standard of mass is a piece of platinum, also kept at the exchequer offices, and weighing 1 lb. avoirdupois.

The **metric** or **centimetre-gram-second** (C. G. S.) system is that most commonly used on the Continent and in many other countries.

The unit of length is a centimetre, the unit of time is a second, the unit of mass is a gram.

The standard of length, 1 centimetre, is a hundredth part of a **metre** which is defined as the ten millionth part of a quadrant of the earth's circumference measured from the North Pole to the Equator.

The standard of mass, 1 gram, is the mass of a cubic centimetre of distilled water at 4° Centigrade.

Formulæ:—

Where v = average velocity, $v = \frac{s}{t}$.

For a body moving from rest in a straight line where v = final velocity gained we have

$v = at$, $s = \frac{1}{2}vt$, $s = \frac{1}{2}at^2$, $v^2 = 2as$

For a body starting with an initial velocity v_0 and having a final velocity v_1

$v_1 - v_0 = at$, $s = \frac{v_1 + v_0}{2}t$, $2as = {v_1}^2 - {v_0}^2$

$s = v_0t + \frac{1}{2}at^2 = v_1t - \frac{1}{2}at^2$

For a rotating body where ω = angular velocity and α = angular acceleration, and v = velocity of a point at a distance r from the axis of rotation, and a its acceleration

$v = r\omega \quad a = \frac{\omega}{t} = \frac{a}{r}$.

For bodies falling freely from a height h

$h = \frac{1}{2}gt^2$, $v^2 = 2gh$, $t = \sqrt{\frac{2h}{g}}$.

For bodies projected downwards with velocity v_0

$v = v_0 + gt$, $s = \frac{1}{2}(v_0 + v)t = v_0t + \frac{1}{2}gt^2$

$v^2 = u^2 + 2gs$

For bodies projected upwards with velocity v_0

$v = v_0 - gt$, $s = v_0t - \frac{1}{2}gt^2$, $v^2 = {v_0}^2 - 2gs$

$t = \frac{v_0}{g}$ where t = time during which body rises

greatest height to which it rises, $h = \frac{u^2}{2g}$

whole time of flight $T = \frac{2v_0}{g}$.

For bodies projected horizontally with velocity v from a height h

$T = \sqrt{\frac{2h}{g}}$.

Range $= s = v\sqrt{\frac{2h}{g}}$.

For bodies projected at an angle to the vertical with a velocity v, where u and v are the vertical and horizontal components of v

$T = \frac{2u}{g}$, $s = \frac{2uv}{g}$, $h = \frac{u^2}{2g}$ where h is the height to which the body rises.

Exercise 6

(1) Two rifles are fired simultaneously from the top of a cliff 144 feet high, one with a velocity of 300 $\frac{\text{ft.}}{\text{sec.}}$ and the other with a velocity of 600 $\frac{\text{ft.}}{\text{sec.}}$. At what distance from the cliff and how long after being fired will they strike the water?

(2) A body is projected upwards with a velocity whose vertical and horizontal components are 38 $\frac{\text{ft.}}{\text{sec.}}$ and 8 $\frac{\text{ft.}}{\text{sec.}}$ respectively. Find its distance from the point of projection after 2 seconds.

(3) Four bullets are fired from the top of a tower 100 ft. high with a velocity of 1,200 $\frac{\text{ft.}}{\text{sec.}}$; one is fired horizontally, one at an elevation of 45°, one at an elevation of 60° and one at a depression of 30° from the horizontal. Find when and where each strikes the ground and the greatest height each reaches.

(4) A projectile is fired from a fort at a ship 3,000 yards distant due N. and steaming E. with a velocity of 500 yards per minute. The horizontal speed of the projectile is 1,000 feet per second. Towards what point in the line of motion of the ship should the projectile be fired?

Question 4 is from London Matric. Exam.

Key to Exercise 4

(1) 20 $\frac{\text{miles}}{\text{hr.}}$; 6 miles. (2) 18·4 miles approximately. (3) 60° west of north; 17·3 $\frac{\text{miles}}{\text{hour}}$ approximately. (4) The sound reached the ground first; $52\frac{4}{11}$ sec. and 1 min. (5) 2 $\frac{\text{feet}}{\text{sec.}}$ to the south-west.

Key to Exercise 5

(1) The actual distance is 12,566·4 centimetres. (2) 9.4 $\frac{\text{radians}}{\text{sec.}}$; $23\frac{1}{2}$ $\frac{\text{ft.}}{\text{sec.}}$. (3) (i) $12\frac{1}{2}$ $\frac{\text{miles}}{\text{hr.}}$; (ii) $7\frac{1}{2}$ $\frac{\text{miles}}{\text{hr.}}$; (i) 20 $\frac{\text{miles}}{\text{hr.}}$; (ii) 0 $\frac{\text{miles}}{\text{hr.}}$. (4) Minute hand ·0346 $\frac{\text{cm.}}{\text{sec.}}$, hour hand ·002 $\frac{\text{cm.}}{\text{sec.}}$ rel. vel. at noon = ·0326 $\frac{\text{cm.}}{\text{sec.}}$. (5) Distance between highest and middle disc: 3 ft.; distance between middle and lowest disc: 5 ft.

M. A. L.

Continued from page 241.

ART AND MUSIC:

Contributors:—THE THEORY OF ART (Hon. John Collier; J. G. B. Lynch). DRAWING AND PAINTING (J. G. B. Lynch). THE THEORY OF MUSIC (R. R. Terry, Mus.Doc., F.R.C.O.; Hubert Grant).

MUSIC.—VIII

A STUDY of music such as we are making shows us a deeply interesting parallel between Art and Nature. Both are characterised by a wonderful process of evolution from rudimentary forms to complex ones.

In the case of Nature, organic life has developed from single cell structures; in the Musical Art the higher forms have developed from simple single sounds. In each domain primitive types have either disappeared or linger precariously in disguise and solitude.

Our modern Musical World supports only those specialised members or groups whose desirable existence has been won by modifications and changes through many centuries. It will be an advantage to us to make ourselves acquainted with them.

The Concert-room

Let us go into the concert-room where many of these musical forms, these finished and classical types of vocal and instrumental pieces, are placed so attractively before us by artists, who in this case are four vocalists—two ladies (soprano and contralto) and two gentlemen (tenor and baritone)—a solo violinist, a solo pianist, and a pianoforte accompanist. The accompanist, be it noted, has to be the *alter ego* —the other self—of his artist-colleague. Their minds must think and act sympathetically together, the pianist unobtrusively aiding and beautifying the work of the singer. But the soloist, independent and individual, must interest the audience in his rendering of a piano solo.

Let us turn to the music. Heading the programme is an "Allegro," from a Sonata for violin and piano, by Beethoven. It is a good choice for an opening; for, in the first place, it is an animated piece of music, a pleasant introduction, therefore. Secondly, the musically-educated in the audience can judge of the calibre of the two instrumentalists by their united performance.

We shall participate in the intellectual pleasure also, if, in addition to the delight the music gives our ears, we understand something about it as a composition—what kind of musical work, say, a Sonata is, and what relation an "Allegro" may have with it.

What is a Sonata?

Let us, therefore, examine a Sonata. Just as a drama is contrived in acts, so a Sonata is constructed in sections—three or four, as the case may be—which sections are called Movements, each of these movements having particular characteristics of gravity or lightness, indicated by a descriptive word, generally Italian. In a Sonata of four movements the arrangement is usually as follows:

In this first movement, *Allegro*, the music proceeds at a quick pace; and the character of it, in different Sonatas, whether bright or tragic, sets the tone of the whole Sonata.

As a drama sometimes commences with a little prologue, so a Sonata does *sometimes*, according to the composer's idea of best arrangement, open with another kind of movement.

Andante, *Adagio*, together with *Largo*, *Grave*, or *Moderato*, are the terms employed usually for the second movement. The violent emotions of the first movement subside into a mood that is calm and temperate, sometimes heavy, grave, and lugubrious, breaking out now and again into passionate chords.

In the third movement, *Menuetto* or *Scherzo*, we get into a fresh atmosphere. We are quit of the poignant emotions, and are allured with the sportive delicate comedy of the *scherzo* or the quaintly dignified grace of the minuet. The idea of the movement is to bring relief to feelings wrought on by the previous movements.

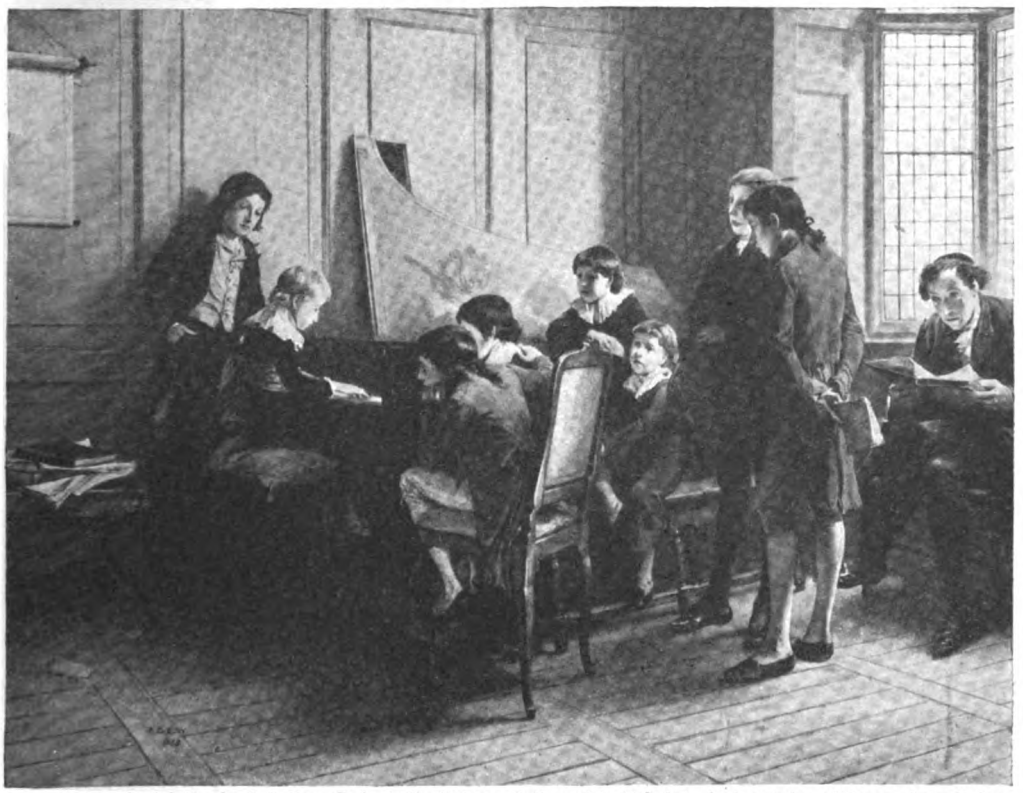
From the picture by C. M. Hardie, R.S.A.: from the "Waverley Novels," by permission of Messrs. A. & C. Black, Ltd.

SCOTT FINDING THE MS. OF *WAVERLEY*

which he finished and published in 1814. He began the novel some years before, but put it aside, where it lay forgotten among some fishing tackle in his lumber-room.

The fourth movement—*Presto*, *Vivace*, or *Allegro*—usually called the *Finale*, is extremely fast. It has not the varied range of feeling of the first or second movements, but it has something of a dramatic character, nevertheless.

It is in the same key as the first movement, and is frequently in "rondo" form—that is, there is one lively principal theme which recurs three or even four times. This theme, with a brief, contrasted second tune and connecting passages, bring the final movement to a captivating finish.



From the painting by A. C. Gow, R.A., in the National Gallery of British Art; by permission of Messrs. Leggatt Bros.

A MUSICAL STORY BY CHOPIN.

Even the usher in the background is forced to listen to his pupil's immature harpsichord rendering.

The features that have been enumerated form a good basis for the appreciation of a Sonata; but there is another aspect of this carefully planned "drama without words" to which we must pay some attention.

There is one characteristic which Sonatas should possess to fit them for "classical" society, and that is the manner in which one, at least, of the movements—generally the first—is put together.

Just as in an Art Song, the composer writes a different melody for the verse in which the emotional idea changes, so the composer of the Sonata, in the movement in which the designation is justified, introduces two contrasted subjects, expressive of different states of feeling, but yet having a certain relationship. This association of two subjects is known in music as the "*binary*" *form.*

In the Enunciation, or First Part of the movement, we have a Chief or Principal Subject—i.e., a melody of a certain number of bars—in what is called the Tonic Key, the key which gives the "tone" to the Sonata, and by which it will be known.

Thus, if the key chosen is D, and the work is the seventh the composer has written, it will be known as: "Sonata, Op. 7, in D." When the first melody has been enunciated, we have a transition to the second subject, which, if the first key is major, will be in the dominant of that key, i.e., its keynote will be a fifth above the tonic.

From D (two sharps) we progress by an ornamental passage to A (three sharps). If,

however, the composer started with a strain in a minor key, he would, for contrast, move into a major, choosing generally the major key related to the minor he began with. Thus, if his first key were D minor, the transition would be into F major, three notes above. These are the methods generally followed by the great classical masters who perfected the Sonata.

When the two subjects have both been enunciated, the composer continues with a Coda, or tail, which is a more or less elaborate preparation for a repetition of the chief subject. The Coda will introduce quotations from each of the two subjects, and sometimes a fresh musical idea.

In the Middle Part or Development, we have what is known as a *free fantasia*, in which devices of polyphony, or the blending of melodies, are pursued with such skill as the composer is master of.

In the Recapitulation the two subjects are heard again, but not quite as before. The themes are contracted, or otherwise a little changed, but they still preserve their characteristics, and the end of the movement is reached with the aid of additional episodes and a striking Coda.

Dance Music

These are the main features of a movement in Sonata form, and without which we have only a *suite*, or succession of pieces. Old *Suites* consisted of more or less idealised and half-forgotten dance tunes strung together, like the *Courante*, so called from its pit-a-pat movement, like running; the *Gavotte*, or dance of the Gavots, inhabitants of Gap, in the Upper Alps; the brawl or braule, which was marked by a bending of the knees and swaying of the body; whilst the *Gavotte* feature is of a jumping character; the *Allemande*, which in France seems to have been a slow, courtly sort of dance, and in Germany of a lively peasant character; the *Passacaglio*, in which the dancers strutted like cockerels and hens; the *Rigodoon*, a jigging, merry sort of tune, and so on.

In regard to the Gavotte, it may be pointed out that whilst the music which is in common time is in some respects similar to that of the Bourrée, the gavotte tune commences on the accented note of the second half of the bar.

The Sarabande, in its settled classical form, is a stately slow melody in $\frac{3}{2}$ or $\frac{3}{4}$ time, with a peculiarity of accent—well-marked in the familiar "Largo in G" of Handel, which, though vocal, is a good example of the ideal Sarabande.

Just as the movements of a Sonata are the developments of the dance forms of the Suite, so the Orchestral Symphony is the highest development of the Sonata. A Symphony is an elaborate orchestral sonata. Beethoven, to make the form more grandiose, added a choir to his orchestra in his Ninth Symphony, the words sung being from Schiller's "Ode to Joy." The work was a £50 commission from the London Philharmonic Society. It was performed in London in 1825, and has marked the boundary of advance in Symphony writing.

A Tenor Ballad

But let us return to our concert programme. Our tenor comes forward to sing a Ballad. This is a term which may be explained. A vocal ballad should deal in its verses with some particular incident or episode in which action involving two or more persons takes place. The Ballad is a story or tale, and differs from the Song which is generally expressive of some emotion or of some state of mind towards things real or conceived, or to persons. "Annie Laurie" and "The Lost Chord" are examples of songs perfect in their way.

The writer of the words of a song of to-day—the simple fashion of "Annie Laurie" being "old-fashioned"—arranges his ideas so that the composer of the music shall be able to have two contrasted themes, with a third musical sentence, as it is called, which shall recapitulate, with embellishment, the first theme.

This style, engagingly developed in melody and accompaniment, gives us the highest form of Art Song. The difficulty of finding poems suitable for musical illustration as songs—unless they are specially written for the purpose—is indicated by the fact that Schubert, one of the most poetical and prolific composers of high-class songs, gleaned his lyrics from the works of over a hundred poets.

The *Aria* which the Soprano is now to sing will be found, like the song, to consist of three parts; but its construction is more mechanical, for it is a typical example of Italian operatic convention. In the first part, the principal melody, which is introduced by a recitative—a brief, half-spoken soliloquising prelude—is sung in its simple form, and is then repeated with much florid ornamentation.

The next part of the aria is a new melody, suave, but plaintive; and the feature of the third part is a brilliant new variation of the principal melody.

The effect of the whole aria, as you will have observed, with its passages of velocity, glitter, and *abandon*, is to please the senses. It has exhilarated, but touched no deep note of emotion.

In listening to this delightful artist you could not fail to notice the exquisite management and control of the voice and vocal organs. How clear and pellucid those rapid runs and divisions were, the notes like rows of matched pearls that touch, but are still distinct; then the will-o'-th'-wisp lightness of the staccato notes, dancing upwards, and the full, rich beauty of that melodious passage in which the words seemed almost a caress.

Atmosphere and Colour

In conversation and in writing about music—more especially in regard to singing—the word "atmosphere" is frequently brought into use. Certain vocalists are said to "create a perfect atmosphere" around their songs.

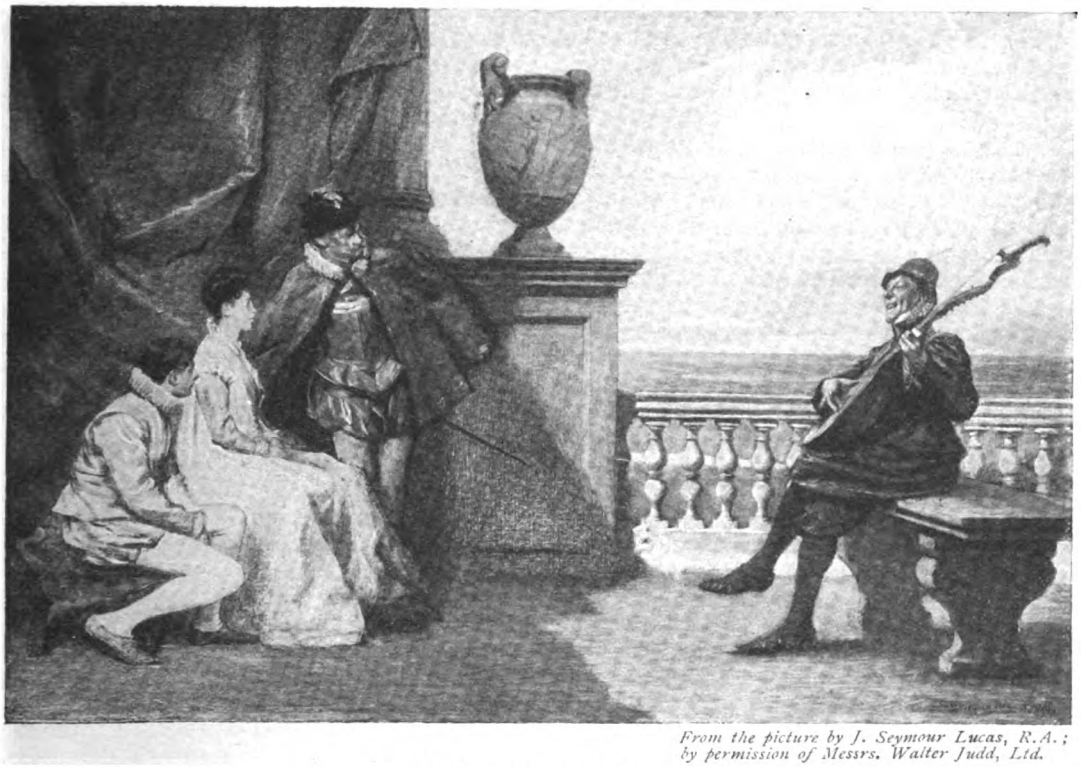
Listen to the deservedly admired baritone who is now singing a little song about an Irish lough, a hill-surrounded lake. Does not his voice give you a sensation of space and water, and a sort of echoing stillness? And listen to him in this Devonshire folk ditty. You hear the old nag pattering along to the market as the rapid syllables fall clear-cut and rhythmic. The journey takes but half a minute, and with whimsical change of voice and manner the singer lands you into the fun of the fair, amidst hale yeomen and apple-cheeked girls, back to a country revel in Tudor times, the golden age of the English ballad singer.

The Piano Soloist

Here comes our piano soloist—a notable personage in the pianistic world. He is round and cheery, and more than middle-aged, and has no time to spare to get his long grey hair trimmed. His smile and glance are ingratiating. You are friendly disposed to him at once.

As he seats himself carefully and comfortably on the previously-adjusted stool, he looks round near about him for some one to whom he can particularly address his playing. It is one of his little idiosyncrasies; but he is really shy, just at the start, and desires to feel *en rapport* with some one in the audience.

H. G.



From the picture by J. Seymour Lucas, R.A.; by permission of Messrs. Walter Judd, Ltd.

"BE YE BLYTHE AND BONNIE."

A charming impression of Tudor England: a family group listening to a gallant singing to his own accompaniment on the lute.

Continued from page 248.

BUSINESS AND COMMERCE:

Contributors:—BOOK-KEEPING (Frederick Heelis, F.C.I.S.). SHORTHAND (by arrangement with Pitman's Schools). COMMERCIAL TRAINING (Arthur Brooke). CHOOSING A CAREER (A. C. Marshall).

CHOOSING A CAREER.—XXIX

Engineering—in its many branches—is a profession which offers many opportunities to the young man of adaptability and creative power who can afford to devote a good many years to acquiring both a practical and a theoretical knowledge of his calling.

So far as the self-educated man is concerned, it would be folly to suggest that he can go so far in the profession as the engineer who has enjoyed all the privileges of expensive apprenticeship and lengthened education.

The master engineer, the individual practitioner as it were, should have received a costly and extensive course of training in addition to all the advantages of a liberal schooling.

At the same time, it may well be said that engineering does offer considerable hopes and prospects to the self-educated student of unusual ability; and many of the important and more or less valuable posts of the profession may fall to this class of workers.

The term engineering is very broad in its adaptation. We have *civil engineers*, men who construct roads, railways, bridges and so on, for civilian purposes; in contradistinction to works for purely military requirements. Then there are *mechanical engineers*, who have to plan and erect all kinds of machines.

There are *mining engineers*, who understand the science of gold, coal and mineral mines; oil; metallurgy and such matters. There are *electrical engineers*, who maintain our electrical power stations, electric traction, telegraphs, telephones, and so on. There are *motor* (or internal combustion) *engineers;* and those who specialise in the engines of aeroplanes and aircraft.

And some of these broad classes may again be subdivided; for there are railway engineers, constructional engineers for steel buildings, well and pumping engineers, naval and locomotive engineers, electric lighting engineers, those who specialise in sewage, and so on.

Practically speaking, however, a youth sets out upon one of these three roads—he will become a civil engineer; a mechanical engineer; or a mining and consulting engineer. These are the three main branches, from which the various subdivisions emanate; and it is quite conceivable that a young man should enter one of these three branches and depend upon the evolution of time and learning eventually to lead him towards his life's work and inclination.

To deal first of all with the young man so provided for that he may stay on at a good school, receiving a sound general education until he is about seventeen years of age. The advantages of this education and the culture so obtained will stand the young engineer in good stead all his life, for engineers are essentially of the cultured classes.

School should be followed by two or three years at a technical Engineering College or Polytechnic, where workshops are provided so that the student may actually come in contact with the practical side of his work. And, after this period, there should come a year or two of service in a works at a comparatively small wage; with regular attendance at lectures, and a considerable part of leisure time devoted to study.

This is perhaps the ideal way of becoming an engineer and of acquiring both the theoretical and practical knowledge required. But, though in no instance may the practical experience of the works be abandoned, the Technical College may be left out for a university career; and practically every university, including those of Oxford and Cambridge, have chairs of engineering at which a knowledge of the scientific and technical aspects of engineering may be acquired.

The cost of a university training is naturally high, especially at the older seats of learning, and a graduate of engineering

would pay no less than for one of theology or any other special subject.

And it should be remembered that the universities grant degrees to graduates; whilst diplomas are to be earned at the lesser colleges and these honours count materially in the progress of a young engineer, particularly when he wishes to obtain official or municipal employment.

But, immediately below the university type of education there are large engineering centres in the country around which have been built up most valuable training colleges, many of which actually ensure that the student shall receive experience in large commercial works and yards.

There is the *University College, London; King's College, Strand, London, W.C.* 2; *the Crystal Palace School of Engineering, London; Faraday House, Southampton Row, London, W.C.* 1; and various polytechnics scattered over the metropolis.

In Scotland, Ireland and the provinces there are the various universities, some of them with dependent schools of engineering, and the *Armstrong College, Newcastle-upon-Tyne*, stands out as a model school, with the advantages of the countless engineering works round the Tyne to assist its students.

At these colleges and schools it may be said that to a great extent the practical and theoretical training proceed side by side; and that a student is turned out at the close of his studies more or less perfect in the rudiments and science of his profession.

The cost varies, of course, according to the class of establishment. Some of the colleges charge at the rate of about fifty guineas a year; others are a trifle cheaper, some more expensive. In addition, the student must be kept and clothed; for he has no opportunity of earning anything at all towards his own support.

The next alternative is to become a premium apprentice to a firm of engineers. By following this plan, the student obtains the practical side of his calling in its best form; he has to be at work at trade union hours, to wear overalls, to become dirtied and to be subjected to all the discipline of the works.

If he is keen and eager he will get on and force his way upwards; if he should be slack there will be no master to push him on and to inspire him, for so long as he does his appointed task the foreman will be perfectly satisfied.

But, in addition to the hard daily grind of the works, it will be essential for the student to attend technical lectures and classes at the close of his day's toil; and to study books and build up the purely theoretical part of his business in his leisure hours. To an eager student this is of course no hardship, but it is problematical if a young man can devote all his attention to mere book lore after a hard day at manual labour.

The premium for apprenticeship varies according to the class of establishment. It may be £50, £100 or £150. In some instances the premium (or part of it) is returned in the form of a small weekly allowance. In some works apprentices are subjected to a system of petty fines, with a view to the better maintenance of discipline.

The period of apprenticeship may be two, three or four years; according to the scholastic or college training of the student, a university man as a rule taking but two years. Originally, the work of the apprentice will lie in the machine shops, in close touch with the actual work of the establishment, but towards the end of his apprenticeship he should have graduated to the drawing office.

Another way of entering the profession is for the beginner to go direct to an engineering works as a paid youthful worker. As such he will have to work harder and be subjected to greater discipline than the premium apprentice; and will probably have less leisure for the purpose of attending classes and acquiring theoretical knowledge.

And, as was explained at the beginning of this lesson, the worker, more or less self-educated, not cultured by having mingled with the professional classes, will have to be a man of exceptional ability and energy if he can succeed in pushing his way above the artisan and worker class, so that eventually he may occupy a directing and highly responsible position.

Nor are these remarks made with a view to discouraging a worker from forming an honest ambition to improve himself. No student should accept these remarks in that way, but should look upon them more in the light of a warning.

One of the chief points to bear in mind is that mathematics are indispensable and that this subject cannot very well be learned in a works. One other point to be remembered is that the vacations at universities are long; and that some students spend only their holidays in gaining practical experience. In other words, it is possible for the university training and the working tuition to proceed almost concurrently. Further, there are certain engineering scholarships and prizes to be won, particulars of which may be had from one's last schoolmaster. A. C. M.

BOOK-KEEPING.—XXIII

WHERE it is intended that the public shall subscribe towards the capital of a concern, the business carried on is often turned into a Limited Liability Company. Broadly speaking, "a Company is an association of many persons who contribute money or money's worth to a common stock and employ it in some trade or business and who share the profit or loss, as the case may be, arising therefrom."

Company Accounts

The commonest class of Companies is the class which is formed under the Companies (Consolidation) Act, 1908. These are classified as "Public" or "Private," and also as "limited" or "unlimited," the limited companies being again subdivided into those limited by shares and those limited by guarantee. The two classes with which the business man comes most closely into contact are public companies limited by shares, and private companies limited by shares. As to other classes, any good work on Company Law will supply the particulars required.

Both private and public companies are formed by the filing of a document called the "Memorandum of Association." This document sets out :—

(1) The name of the Company, with "Limited" as the last word.

(2) The situation of the Registered Office.

(3) The objects of the Company.

(4) That the liability of members is limited, and

(5) The amount of share capital and the division thereof into shares of a fixed amount.

From a Book-keeping point of view the most important of these provisions is the statement as to the amount of share capital. The amount stated in the Memorandum is called the "Nominal Capital." In a public company this nominal capital, or a part of it, may be offered to the public for subscription, that part which is so offered being called the "Issued Capital." In the case of a private company the issued capital is offered only to certain individuals.

That amount of capital which is taken up (or applied for) is called "Subscribed Capital." It may be found that the full value of the capital subscribed is not immediately required. It is usually subscribed by a given amount being paid on application, a further sum on allotment, and the balance is "called up" either at stated times or as required. When the whole of the capital has been called up and paid, the subscribed capital is "Paid-up Capital"; e.g., suppose the capital authorised is £8,000, the Company may offer £5,000 for subscription. If this is all taken up, as it may be, the subscribed or issued capital of the Company is £5,000. In its turn this amount may not all be required at once, in which case the shareholders may be called upon to pay £2,500, remaining liable for the further £2,500 to be paid as called.

Forming a Company

Again, suppose that Thomas Underton has been carrying on an old-established business which he desires to sell for £80,000. The sole owner of the business, Thomas Underton, wishes to be the chief shareholder in a public company to be formed. A limited liability company might be created for the purpose of purchasing the business. Thomas Underton becomes the vendor, and the Company, a separate and distinct entity, is the purchaser. It is decided that the nominal capital as stated in the Memorandum of Association shall be £100,000, consisting of 50,000 Ordinary Shares of £1 each, and 10,000 six per cent. Preference Shares of £5 each.

THOMAS UNDERTON.

BALANCE SHEET, DECEMBER 31ST, 19...

LIABILITIES.	£	s.	d.	ASSETS.	£	s.	d.
Bills payable	4,000	–	–	Cash	2,000	–	–
Sundry Creditors ..	10,000	–	–	Bills receivable ..	1,500	–	–
Capital	66,000	–	–	Book debts	20,000	–	–
				Freehold premises ..	35,000	–	–
				Plant and machinery ..	10,000	–	–
				Stock	8,000	–	–
				Furniture, etc. ..	3,500	–	–
	£80,000	–	–		£80,000	–	–

JOURNAL.

19..			Dr. £	s.	d.	Cr. £	s.	d.
Jan.	1	Purchase a/c .. .. Dr.	80,000	–	–			
		To Thos. Underton				80,000	–	–
		as per agreement dated Jan. 1st, 19...						
		Sundries :— Dr.						
		Cash	2,000	–	–			
		Bills receivable	1,500	–	–			
		Sundry debtors	20,000	–	–			
		Freehold premises	35,000	–	–			
		Plant and machinery	10,000	–	–			
		Stock	8,000	–	–			
		Furniture and fixtures	3,500	–	–			
		Goodwill	14,000	–	–			
		To purchase a/c				94,000	–	–
		Sundry assets as acquired under agreement dated Jan. 1st, 19..						
		Purchase a/c .. .. Dr.	14,000	–	–			
		To Bills Payable				4,000	–	–
		„ Sundry Creditors				10,000	–	–
		Sundry Liabilities taken over under agreement dated Jan. 1st, 19..						

In addition, £25,000 in Debenture Bonds of £100 each are to be issued. Mr. Underton's Balance Sheet at the time of the purchase was as shown on p. 310.

In the Journal entries, so far as we have taken them, it will be noted that Goodwill £14,000 appears. The student should note that the purchase price is £80,000, and the balance of assets over liabilities is £66,000. The company is paying £80,000 for assets valued at £66,000. We know that Thomas Underton's business is an old-established one, and therefore has a connexion upon which the owner is entitled to place a value. This amount, £80,000, less £66,000, is the value of "goodwill."

As to Shares the Journal continues :—

It is arranged that the £80,000 shall be paid in the following amounts :—

20,000 fully paid Ordinary Shares of £1 each,

4,000 fully paid Preference Shares of £5 each, and

200 Debenture Bonds of £100 each,

the balance being in cash. As cash is required for the carrying on of the business of the company, the remainder of the shares and debentures are to be offered to the public. If all these shares and debentures are subscribed, the Journal and Cash Book

JOURNAL (Contd.)

19..			Dr. £	s.	d.	Cr. £	s.	d.
Jan.	1	Ordinary Shareholders .. .. Dr.	30,000	–	–			
		To Ordinary Share Capital—						
		30,000 Shares of £1 each				30,000	–	–
		Preference Shareholders .. .. Dr.	30,000	–	–			
		To Preference Share Capital—						
		6,000 Shares of £5 each				30,000	–	–
		Debenture Holders .. .. Dr.	5,000	–	–			
		To Debentures—						
		50 Bonds of £100 each				5,000	–	–
		Thos. Underton (vendor) .. .. Dr.	60,000	–	–			
		To Ordinary Share Capital—						
		20,000 Shares of £1 each				20,000	–	–
		To Preference Share Capital—						
		4,000 Shares of £5 each				20,000	–	–
		To Debentures—						
		200 Debenture Bonds of £100 each				20,000	–	–
		Shares and Debentures issued as fully paid in part payment of purchase price under agreement dated Jan. 1st, 19..						

entries, and the company's Balance Sheet at the date of incorporation, will be as follows :—

Cash. CASH BOOK. *Contra.*

	£	s.	d.		£	s.	d.
To Balance (Cash) ..	2,000	–	–	By Thos. Underton,			
„ Ordinary Shareholders	30,000	–	–	Vendor	20,000	–	–
„ Preference „	30,000	–	–				
„ Debenture Holders	5,000	–	–	By Balance c/d	47,000	–	–
	£67,000	–	–		£67,000	–	–
To Balance b/d	£47,000	–	–				

STATEMENT OF ASSETS AND LIABILITIES OF THOMAS UNDERTON & CO., LTD., AT INCORPORATION.

LIABILITIES.	£	s.	d.	ASSETS.	£	s.	d.
Nominal and Issued Capital.				Freehold Premises ..	35,000	–	–
				Goodwill	14,000	–	–
Ordinary Share Capital				Plant and Machinery	10,000	–	–
50,000 Shares at £1				Furniture and Fixtures	3,500	–	–
each	50,000	–	–	Stock	8,000	–	–
Preference Share Capital				Sundry Debtors ..	20,000	–	–
10,000 Shares at £5				Bills receivable	1,500	–	–
each	50,000	–	–	Cash in Bank	47,000	–	–
Debentures.							
250 Bonds at £100 each	25,000	–	–				
Sundry Creditors ..	10,000	–	–				
Bills payable	4,000	–	–				
	£139,000	–	–		£139,000	–	–

Where a new business is created, the Journal entries in respect of Shares will be similar to the table at the bottom of p. 311. This aspect will be examined more fully later.

Definitions of Terms

Classes of Shares.—The classes of shares generally known in practice are ordinary, preference, and deferred shares, but where there are several issues we may find subdivisions of the ordinary and preference, e.g. Preference A or 1st Preference, 2nd Preference.

Preference Shares.—Preference shares mean such shares as are issued by the company as being entitled to priority over ordinary shares as to dividend, e.g. "five per cent. preference shares" means that the holders of such shares are entitled to a five per cent. dividend before the holders of ordinary shares receive anything.

Cumulative and Non-Cumulative Preference Shares.—Preference shares may be cumulative, that is, if in any given year the profits of the company do not warrant the full or any dividend on such shares, the right to receive the dividend will be carried over to the next year or succeeding years. Preference shares are deemed to be cumulative, if the Articles do not provide otherwise. Non-cumulative shares are entitled to the specified dividend from the profits in any year, the deficiency not being carried over.

Deferred Shares.—Deferred shares, or as they are sometimes called "Founders'" shares, are usually issued to the persons who carried on the business taken over by the company. Generally such shares are allotted as fully or partly paid in consideration of the sale of the business, or for services rendered in the formation of the company. The rights of the holders of such shares are a matter of agreement on the formation of the company.

Apportionment.—Some payments made annually do not cover the same period as annual accounts of the business. Thus, if the financial business year ends March 31st and rent is paid half yearly in advance in January and July, the half year's rent paid in January covers part of the next year from April 1st to July. This is generally apportioned between the two financial years, and the portion from April to July will appear as an asset in the Balance Sheet, and the portion January to April be charged against Profit & Loss. Other payments such as Insurance, Rates, etc., are similarly apportioned.

F. H.

Continued from page 251.

ENGLISH LANGUAGE AND LITERATURE:

Contributors:—ENGLISH LANGUAGE (W. A. Craigie, M.A., LL.D.; E. W. Edmunds, M.A.). ENGLISH LITERATURE (John Derry, J.P.). PHILOSOPHY (E. H. Tripp, Ph.D.). POLITICAL ECONOMY (J. W. Urwin). ETHICS (W. H. Koebel). PUBLIC SPEAKING (J. W. Urwin).

THE NOVEL—III

SIR WALTER SCOTT (the story of whose life will be found outlined in the chapters dealing with the poetry of the nineteenth century) was in his forty-third year when, in 1814, he finished and published his first novel—*Waverley*. He had begun the book some years before but had forgotten it, until one day he found the half-finished MS. among some fishing tackle in a lumber room at Ashestiel. The last of the novels which sustained the reader's interest and author's reputation, *Anne of Geierstein*, was written fifteen years later.

In the fourteen years that intervened Scott produced fourteen novels that reached or overtopped the high average standard of achievement which his work had established, and during these years or later he wrote a dozen other tales that fall below his standard. Within the same period two of his considerable poems were published, and a vast amount of historical and biographical writing and literary criticism. History contains no similar record of literary productivity.

Sixteen Great Novels

The sixteen stories which support the claim that Scott is the greatest of the world's novelists are *Waverley*, 1814; *Guy Mannering*, 1815; *The Antiquary*, 1815; *Old Mortality*, 1816; *Rob Roy*, 1817; *The Heart of Midlothian*, 1818; *The Bride of Lammermoor*, *Legend of Montrose*, and *Ivanhoe*, 1819; *Kenilworth*, 1821; *The Fortunes of Nigel*, 1822; *Quentin Durward*, 1823; *Red Gauntlet*, 1824; *Woodstock*, 1826; *The Fair Maid of Perth*, 1828; and *Anne of Geierstein*, 1829.

All these stories may be regarded as historical, the only one that describes a state of things within half a century of the time of writing being *The Antiquary*, which dated back about a quarter of a century.

Scott, indeed, took the past for his province, and founded the novel that is broadly faithful to its historical setting, though he does not bind himself by a strict accuracy. He recasts, for instance, the story of Amy Robsart in *Kenilworth*, and historians, who know now more than he could possibly have known about some of the periods into which he introduces his readers, have made themselves busy with his anachronisms, but the general result is that he gives the reader who is not a student of detail a living and helpful picture of any age in which his characters are placed.

Scott as a Novelist

Why is it that Scott takes, among British writers whose theme is human life and character, the next place to Shakespeare? Like Shakespeare, he wrote in great haste, without aiming at literary perfection, or even polish, and his work is open to criticism from the most casual reader. Sometimes he overloaded his writing with discursive history, or the products of his wide reading in the domains of archæology and romance. His tales, as was certain to be the case in pioneer fiction, have not the compactness, well-planned movement, and avoidance of redundancy that have been attained since by the masters of plot and of novel construction. He was not consciously a student of psychology, nor a portrayer of growth and change of character. And yet there is no novelist like him. He stands apart, the supreme story-teller.

The secrets of his charm are that he was a great-hearted man, who delighted in every marked phase of human character, which he saw with interpretative sympathy and a rich, deep humour. His range of apprecia-

tion of women was wide, and of men was almost illimitable. No writer except Shakespeare has approached him in the universality of his understanding of men, or the power of making them appear real. They are men as certainly as any man we have known in the flesh, clear additions to our personal acquaintances, and never to be forgotten.

Then, too, the purpose of his writing, like that of Shakespeare, was—to please. He wrote for our delight, with no secondary object lurking underneath.

And, most of all, Scott was a natural, born story-teller. The moment his narrative breaks into a tale-like recital he holds us with a spontaneous charm. Further, over all his work is flung the warmth of his manly, magnanimous nature, wholly sound and sweet, irradiated by humour, and without a trace of cynicism or pettiness. Such health and breadth are tonic in the highest degree. Fiction in Scott's hands takes a place with great recuperative influences like exercise in the open air, the call of the earth's loveliness, and the quickening power of friendship.

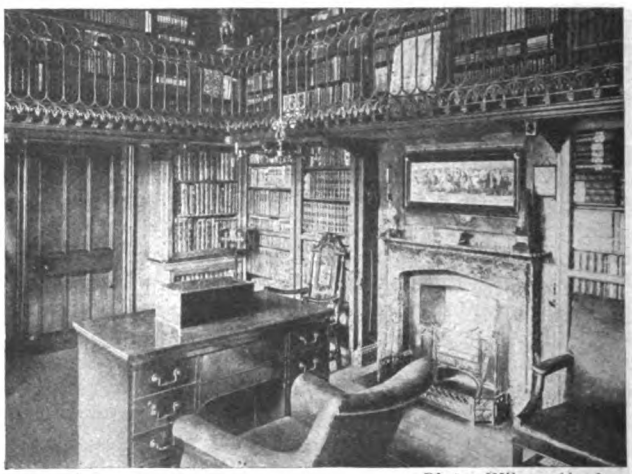


Photo: Wilson, Aberdeen.

SIR WALTER SCOTT'S STUDY AT ABBOTSFORD.

With Scott's stories scenery as a background for human emotion became an important adjunct to fiction—the scenery of well-defined localities. When the earlier novelists took their readers into the country they were vague ramblers. It is true that Miss Edgeworth fixed the scenes of some of her tales in Ireland, Mrs. Radcliffe imagined romantic forests as haunted by her mysteries, and Miss Austen wrote almost entirely of rural England ; but nowhere was the scenery of fiction so recognisable as to bring in the charm of definite place. That was left for Scott. Indeed, his mind, though finely imaginative when started, seemed to need some material foundation to build on, such as an historical outline, or the character of someone whom he had observed, or a scene he had watched with delight.

Round those nuclei his imagination played, and one result is that he has peopled many distinctly recognisable districts of England and Scotland with the men and women of his creative genius, and so has enriched their associations, and founded the novel of neighbourhood as well as the novel of history.

It is not always realised how closely Scott is linked through his young contemporaries with readers of the present day who do not yet regard themselves as old. Edward Bulwer, afterwards Lord Lytton, and Benjamin Disraeli, afterwards Earl of Beaconsfield, were both writing novels before Scott's death, and they continued writing them into the seventies of the nineteenth century, while Thomas Love Peacock, who will always have literary readers but will never be popular, published his first satire in fiction only four years after *Waverley* was issued, and continued writing until 1860.

To these writers, and to Fenimore Cooper, the pioneer of American fiction, and Captain Marryat, the successor of Smollett in carrying on the literature of life at sea, more or less extended reference must be made before we reach the period when Charles Dickens used the novel as a mirror, not for historic scenes, nor polite society, nor the political kaleidoscope, nor social coteries, but to reflect the mass of the English people as they may be seen humorously through their oddities.

Susan Ferrier was for twenty years an intimate friend of Scott, and helped, by her tactful companionship, to cheer him when his memory was failing. Her father had been a colleague of his in the law work of his early years. Miss Ferrier, who was born in Edinburgh in 1782, published three novels —*Marriage*, in 1818, but written in 1810, *Inheritance*, 1824, and *Destiny*, 1831.

These books, which in construction show a progressive skill, are racily humorous and somewhat satirical descriptions of Scottish types of character and the foibles of the society of the period, based largely on well-known personages, and they still retain a

lively interest. Miss Ferrier modestly preferred to write anonymously, and her name was not given in her books until 1850, four years before her death.

John Galt, who was born at Irvine in 1779, and died a poor man at Greenock in 1839, lived a busy and adventurous commercial life involving much travel, that was interspersed with the writing of many books. His literary labours in history, biography, the drama and travel are all forgotten, but his tales of the humours and simplicities of Scottish rural life have a permanent value.

The Ayrshire Legatees appeared in 1820, in early numbers of "Blackwood's Magazine," and prepared the way for *The Annals of the Parish* in 1821, a book in which Galt reached his high-water mark. *The Ayrshire Legatees*, written in letters, after the manner of Smollett's "Humphry Clinker," tells of the visit to London of a Scottish minister's family to receive a legacy. The *Annals* is an extended sketch of parish life as seen by a pious, simple, broad-minded minister, possessed of the grace of humour. *The Entail* and *The Provost* were further tales by Galt.

Thomas Love Peacock published his first satire, *Headlong Hall*, in 1816, and the rest of his stories, except one, before the death of Scott. They were *Melincourt* (1817) and *Nightmare Abbey* (1818), social, political, and literary satires, the latter with Shelley, slightly disguised, as its hero; *Maid Marian* (1822) and *The Misfortunes of Elphin* (1829), romances veiling satire; *Crotchet Castle*, generally regarded as the strongest story, with least exaggeration, the satire now being turned against the author's earlier friends of reform; and *Gryll Grange*, published in 1860, more chastened in style, but expressing amusingly an old man's hatred of change.

Peacock's stories are intensely personal. He belonged to no school of fiction, but used the novel to express his own ideas, which were always strong and inclined to be crabbed, but were launched at the reader with a brilliant ingenuity. *Maid Marian*, the story of Robin Hood, is much the easiest of the tales to read.

From the portrait by Sir Henry Raeburn, R.A.

SIR WALTER SCOTT (1771–1832),

the supreme story-teller: a novelist without a peer.

Peacock was born at Weymouth in 1785, and until his thirty-fourth year lived a life of self-sought learning, writing, and wandering. He was then appointed to a post in the office of the East India Company, and during thirty-five years' service proved an excellent business man. He died in 1866, after enjoying a handsome pension for ten years. All his life he wrote verse without distinction, except, curiously, that the lyrics he scattered plentifully through his novels have a happy brightness, swing, and humour. Perhaps the most characteristic is the robust, humorous, gloatingly satirical *War Song of Dinas Vawr*, from *The Misfortunes of Elphin*:

On Dyfed's richest valley,
  Where herds of kine were browsing,
We made a mighty sally,
  To furnish our carousing.

Fierce warriors rushed to meet us;
  We met them and o'erthrew them:
They struggled hard to beat us;
  But we conquered them, and slew them.

Mary Russell Mitford, one of the sweetest-natured of women and most artistically simple writers of English prose, was born at Alresford in Hampshire in 1787, and lived all her life amid surroundings similar to those of Jane Austen. The calamity of her existence was a worthless, spendthrift, gambling father, who flung away £70,000 and then sponged on his uncomplaining daughter till she ruined her health by her literary exertions to keep him in lazy self-indulgence.

Miss Mitford believed herself first a poet, then a dramatist—and indeed she made some temporary remunerative success with plays—but she is known to posterity only by her delightful cameos of village life, which, under the title *Our Village*, grew into five volumes between the years 1819 and 1832. Her writing illustrates how narrow a range of human life will yield literature if it be pictured with simple truth and charm. Her chapters often combine the descriptive sketch with the short story taken from life, softly irradiated by a kindly humour.

James Fenimore Cooper, the first noteworthy and the most widely read American novelist, was born in 1789 in New Jersey, but lived as a boy in an unsettled forest district of New York State, where his father, a judge, had an extensive property. After experience at sea Cooper joined the American Navy, and rose to be a lieutenant, but resigned on his marriage at the age of 21, and took to farming.

Fenimore Cooper and Ainsworth

Ten years later he began novel writing, his first attempt, in 1820, being unsuccessful. Next year he became famous through *The Spy*, a story which includes a striking character-sketch of Washington. Between 1823 and 1841 he wrote a sequence of five tales on which his fame as a novelist is founded.

The sequence of the stories—not the order in which they were written—is *The Deerslayer*, *The Last of the Mohicans*, *The Pathfinder*, *The Pioneers*, and *The Prairie*. Read in this rotation they become a great connected account of the gradual settlement of the United States from the coast inland to the prairie, and through them all, growing older from story to story, passes the great character Leatherstocking. Only when he is judged by the fulfilment of his general plan of a prose epic—telling stage by stage of the clearance of the American woodlands—can Fenimore Cooper be properly estimated.

Criticism of his style is easy. His diction is often pompous, and does not fit the speaker who uses it. His moralising becomes tiresome. Many of his characters are lay figures. But his favourite characters are finely and consistently drawn. His narrative moves with vigour when it gets fairly on the trail. And there is breadth and strength in the realisation of national change as the old hunter, lover of the forest and expert in its craft, is gradually forced to die on the treeless prairie. Though Cooper wrote in the English idiom, before an American variety of speech arose, he is the most truly national of all the American novelists.

William Harrison Ainsworth (1805-1882) was the son of a wealthy Manchester solicitor, but insisted on becoming a novelist. His first story, published in 1826, was praised by Scott, but he did not score a success till he introduced the highwayman Dick Turpin into his *Rookwood*. Romantic crime was further developed in *Jack Sheppard* (1839). Then, from 1840 onward Ainsworth settled down to the writing of the semi-historical novels for which he is still read—*The Tower of London*, *Old St. Paul's* (his best work), *Windsor Castle*, *Guy Fawkes*, etc. Beginning with *Lancashire Witches*, he wrote a number of stories illustrating Lancashire historical incidents, and is regarded by Lancashire readers as their county-novelist.

Ainsworth's historical canvas was often too fancifully embroidered, and his writing inflated and hasty, but he was vigorous in description and could sustain briskness of movement throughout a stirring episode.

G. P. R. James and Capt. Marryat

G. P. R. James (1799-1860), grandson of the Dr. James whose powders, recklessly taken, killed Oliver Goldsmith, wrote much history (for which he was appointed Historiographer Royal to William IV.) and historical novels by the score. The best were *Richelieu* (1829) and *Henry Masterton* (1832). His grandiloquent fluency was very popular, and was unabated for twenty years. James travelled a good deal and during his last ten years was a Consul abroad. An element in his popularity was that the moral tone of his works was irreproachable.

Captain Frederick Marryat, the most breezy, humorous and faithful of all the novelists who have described life at sea, wrote about scenes he was intimately familiar with. Born in London in 1792, son of a merchant who was chairman of

Lloyds, and an M.P., Marryat went to sea when he was fifteen, and served with distinction for four-and-twenty years. He is said to have taken part in fifty fights. He gained the C.B. and the French Legion of Honour, was elected F.R.S. for scientific research, and won the Humane Society's Medal for gallantry in saving life at sea. No man could have been better qualified to write of "life on the ocean wave," and expand the type of sea-story begun by Tobias Smollett.

Before he resigned the command of H.M.S. *Ariadne*, in 1830, Marryat had decisively made his mark as a writer in *Frank Mildmay*, an autobiographical novel published in 1829, and *The King's Own*, published in 1830. His greatest successes were his books issued between 1834 and 1836—*Peter Simple*, *Jacob Faithful*, and *Mr. Midshipman Easy*; and, later, in his tales for boys, of which the best are *Masterman Ready* and *The Settlers in Canada*, he reached a fresh distinction.

Captain Marryat was weak in his plots, but as a writer of stirring narrative, close to life, vivid and dramatic, he takes high rank. He sketches character clearly and consistently, with a special bent towards the eccentric. That his overflowing humour should be boisterous is not out of keeping with the rough life he depicts. A breezy, manly writer, Marryat is the least affected of our novelists who have just failed in achieving greatness.

Lord Lytton: Dandy, Politician—

Edward Bulwer, renamed Bulwer-Lytton, and later created Lord Lytton, is one of the most tantalising figures in our literary history. In his time he "played many parts" as a writer—played them with considerable, but never supreme, success. He was too much of an all-round man to escape superficiality. Egotistical and showy, he lacked concentration and sincerity, though at every point he was clever.

He was born in London, in 1803, with family pride both on the side of his father, the Bulwers, and of his mother, the Lyttons. He was educated privately and at Cambridge, and then became a society dandy with a romantic air, on an allowance from his mother. Her he offended by marrying, in 1827, an Irish beauty with no fortune, and the allowance being discontinued he rushed into print with prodigious energy to earn a living. In this he succeeded, for there was nothing he could not write; but the marriage proved a pitiable failure, for mother, son, and wife were ill-balanced.

Twice Lytton entered Parliament, first as a Liberal, and later (1852) as a Conservative. For a short time (1858-59), under Lord Derby's Government, he held the Colonial Secretaryship, and on Derby's return to power he was raised to the peerage in 1866. His baronetage had come in 1838 from the Liberals. He assumed the name of Lytton on succeeding to his mother's Knebworth estate in 1843. His parliamentary life was punctuated by a few brilliant set speeches. Lytton died in 1873, leaving a son, the first Earl Lytton, who was a truer poet and a more accomplished statesman than his father.

Lord Lytton's real fame, of course, is literary. He wrote poetry fluently, without distinction. Between 1838 and 1840 he furnished Macready with three successful plays, *The Lady of Lyons*, *Richelieu*, and *Money*, all of which are workmanlike productions, and retain a hold upon the modern stage.

—and Novelist

But it is by his novels that Lord Lytton will be most generally known, and their variety is so great that while they do not in any instance possess the power or the charm that captivates the reader they must long remain an interesting literary phenomenon. They arrange themselves by their subjects and treatment into at least six groups.

First came the novel of the ambitious, romantic, clever dandy, who was out to conquer the world. Lytton himself, but slightly disguised, is the central figure, and *Pelham* (1828) the key book of the type. It is the most concentrated, vivid, and sincere book of the novelist's whole career, though far from being the most admirable.

Then came a series of studies in crime, the most prominent examples being *Paul Clifford*, the highwayman (1830), and *Eugene Aram*, the murderer (1832). These books partly responded to and partly created a passing gust of morbidity.

The novelist next entered upon a far more responsible section of his life's work—his historical tales. Here he used a good deal of careful and laborious research, and his *Last Days of Pompeii* (1834), *Rienzi* (1835), *The Last of the Barons* (1843), and *Harold* (1848) command respect by the skill with which imagination is superimposed on fact. The weakness of the stories is that they are studies rather than literature. They do not draw and charm us.

In the 'fifties, Lytton struck out upon a new line—a portrayal of family life in rural surroundings, and it will be generally agreed that *The Caxtons* (1849), *My Novel* (1853) and *What will he do with it?* (1859) have a closer hold on real life than any of his other writings, though their leisurely pace is an affectation.

Another strain recurring again and again is a dallying with the supernatural. It appears in *Zanoni* (1842) and *A Strange Story* (1862), and the tendency is allowed greater freedom under the guise of science in *The Coming Race* (1871), perhaps the most thoughtful, and certainly one of the best written, of all Lytton's sixty books. In it a long-cherished vein of superstition, prying for wonders, found through science scope for the boldest flights of fancy, and a very striking book was evolved.

Lastly, in his closing years, the novelist was beginning to write trenchant studies of the developments, manners and customs of the "parvenus" of modern society. *Kenelm Chillingly* (1873) and *The Parisians* (1873) are the books of this final phase.

A sympathetic but frank study of Lytton leaves the reader with a sense of pathos that so much energy and talent should arrive so near to literary greatness and yet miss it.

From a drawing by Daniel Maclise, R.A., reproduced from "Fraser's Magazine," 1839.

WILLIAM HARRISON AINSWORTH (1805–82).

Benjamin Disraeli, Earl of Beaconsfield (1804-1881), was only secondarily a writer. He used the novel partly as a lever to raise himself into notice, and partly as a means of expressing his political aims. For the first of these purposes *Vivian Grey* (1826), *The Young Duke* (1831) and *Contarini Fleming* (1832), bravely rhetorical and glittering with epigram, sufficed.

They show the dash and daring of the young man who has a splendid belief in himself, a contempt for all forms of old fogydom, and who means to be heard. They served their purpose and won for their author a place on the public stage in the limelight, and they should not be read either as literary examples or political manifestoes.

Quite otherwise must the next group of Disraeli's novels be regarded. *Coningsby* (1844) and *Sybil* (1845) were written when their author was rising rapidly into the position of a leader of one of the great parties in the British Parliament, and these books embodied his ideas of what his party's aims should be. In short, they were political novels written to have a reconstructive effect.

Disraeli realised that government by the landed proprietary through electoral influence was out of date; that the Poor Law in the country and the factory system in towns were acting as an intolerable tyranny; and he sought to bring about a new constitutional balance, by an extension of popular privileges, an increased use of the influence of the Church, and by conferring greater powers on the Crown.

These were the ideas that underlay his political novels. They only came to fruition in part. In the end he helped to broaden the franchise, and to endow the Crown with greater ceremonial dignity. His novels served doubtless to fertilise the minds of his Party. But political novels, written with a purpose, to suit the rapidly changing conditions of a controversial period, cannot be regarded as playing an important part in literary evolution.

Disraeli's novels are interesting politically, and for the insight they give into the mind of a most remarkable man, but in relation to the great drama of fiction they occupy a small place. Two other novels, *Lothair* (1870) and *Endymion* (1880), were the recreations of their author's later years, and showed only his interest in turning the kaleidoscope of political personalities.

Charles Dickens is the only British novelist who vies in popularity with Sir Walter Scott. If the measurement of popularity be made by cordiality of feeling, width of critical appreciation, and sustained sales these two writers form a class by themselves.

In one respect Scott and Dickens are alike —they awaken in admirers an appreciation

that is charged with warm affection. Both were in love with human nature, and so appealed straight to the heart. Both had in an unsurpassed degree tenderness, more manly in Scott, more sentimental in Dickens; and humour deeper-toned in Scott, more copious and exuberant in Dickens. Dickens, more than Scott, is judged by the heart, and has the greater need of its disarming prepossessions.

Only about seven years separate the time when Scott, though growing old, was writing (as in *Anne of Geierstein*) with adequate vigour, and the time when Dickens, young and bubbling over with high spirits, was beginning to write *Pickwick*. But Dickens did not find inspiration in Scott. He was first influenced in style by Leigh

From a drawing by Daniel Maclise, R.A., reproduced from "Fraser's Magazine," 1833.

BENJAMIN DISRAELI (1804–81).

Hunt among his contemporaries, and by Smollett among earlier writers, but soon became himself and struck out into forms of fiction that were entirely original and have never been successfully copied.

No writer of fiction has been more representative of the spirit and sentiment of the age in which he lived than Charles Dickens. Partly he was formed by that spirit and partly he formed it, while to some extent he reformed it, but throughout he belonged to it. Scott could project himself into a distant age and be reconstructively at home in it. In that respect he resembled Shakespeare. But Dickens was essentially a man of his own times, vividly interested in all he saw around him; and though, in two of his books, he reverted to a somewhat earlier day, but a day that was still influencing his own period, the great mass of his writing was about men and conditions he knew by personal observation—a transcription from life.

From a drawing by Daniel Maclise, R.A., reproduced from "Fraser's Magazine," 1832.

EDWARD BULWER, LORD LYTTON (1803–73).

It was this absorption in the life of his times that made him a reformer, or rather a stimulator of the sentiments that were bound to culminate in reform. And so it came to pass that the poor-house, the law courts, education, slum problems, and what, later, were called social questions were brought into his books, and fiction for the first time was used by him as a powerful lever for moral advancement.

Dickens bore ineffaceably the stamp of his early struggles, an experience which gave him an almost unparalleled knowledge of the Victorian "lower classes." He wrote with sincere moral courage, but with an unfailing eye for the humorous trait or situation and with a desire for the universally eccentric, evolving a style articulate with perhaps too much of the sentimental and theatrical for modern ideas. J. D.

Continued from page 258.

HISTORY:

Contributors:—J. A. Brendon, B.A.(Oxon.), F.R.Hist.S.; F. Collinson, F.R.Hist.S.; T. P. Evans, B.A.(Oxon.); James A. Manson; L. Stampa, M.A.(Oxon.); and J. B. Sterndale-Bennett.

BRITAIN'S STORY.—XIII

[*The introductory chapter to* LORD MACAULAY'S "*History of England*" *has been adopted in this work to explain the development of the British race prior to* 1660. *But as Lord Macaulay's work was intended merely as a sketch, explanatory passages (printed in closer type) have been interpolated in order to meet the requirements of the student.*]

THE nation had been put into good humour by the prospect of seeing constitutional government restored and grievances redressed. The new House of Commons was more temperate and more respectful to the throne than any which had sate since the death of Elizabeth. The moderation of this assembly has been highly extolled by the most distinguished Royalists, and seems to have caused no small vexation and disappointment to the chiefs of the opposition: but it was the uniform practice of Charles, a practice equally impolitic and ungenerous, to refuse all compliance with the desires of his people, till those desires were expressed in a menacing tone. As soon as the Commons showed a disposition to take into consideration the grievances under which the country had suffered during eleven years, the King dissolved the Parliament with every mark of displeasure.

The Exactions of Charles I.

Between the dissolution of this shortlived assembly and the meeting of that ever memorable body known by the name of the Long Parliament, intervened a few months, during which the yoke was pressed down more severely than ever on the nation, while the spirit of the nation rose up more angrily than ever against the yoke.

Members of the House of Commons were questioned by the Privy Council touching their parliamentary conduct, and thrown into prison for refusing to reply. Ship money was levied with increased rigour. The Lord Mayor and the Sheriffs of London were threatened with imprisonment for remissness in collecting the payments. Soldiers were enlisted by force. Money for their support was exacted from their counties. Torture, which had always been illegal, and which had recently been declared illegal even by the servile judges of that age, was inflicted for the last time in England in the month of May, 1640.

Everything now depended on the event of the King's military operations against the Scots. Among his troops there was little of that feeling which separates professional soldiers from the mass of a nation and attaches them to their leaders. His army, composed for the most part of recruits who regretted the plough from which they had been violently taken, and who were imbued with the religious and political sentiments then prevalent throughout the country, was more formidable to himself than to the enemy.

Disaffection In Scotland

The Scots, encouraged by the heads of the English opposition, and feebly resisted by the English forces, marched across the Tweed and the Tyne, and encamped on the borders of Yorkshire.

And now the murmurs of discontent swelled into an uproar by which all spirits save one were overawed. But the voice of Strafford was still for Thorough; and he, even in this extremity, showed a nature so cruel and despotic, that his own pikemen were ready to tear him in pieces.

There was yet one last expedient which, as the King flattered himself, might save him from the misery of facing another House of Commons.

To the House of Lords he was less averse. The Bishops were devoted to him; and, though the temporal peers were generally dissatisfied with his administration, they were, as a class, so deeply interested in the

From the picture in the Royal Exchange by Solomon J. Solomon.

CHARLES I. AT THE GUILDHALL DEMANDING THE ARREST OF THE FIVE MEMBERS

of the House of Commons—John Pym (Tavistock), John Hampden (Buckinghamshire), Denzil Holles (Dorchester), Sir Arthur Haselrig (Leicestershire) and Sir William Strode (Dorchester). In January, 1642, the King, believing that the Parliamentary leaders intended to impeach the Queen, tried to prevent it by impeaching her assailants. On January 4th he went with 80 armed men to the House of Commons, where he found that "the birds were flown." The King's action caused much commotion; the House adjourned till the 11th, appointing a committee to sit in the meanwhile at the Guildhall. This committee so strongly condemned the King's action that he decided to adopt other measures.

maintenance of order, and in the stability of ancient institutions, that they were not likely to call for extensive reforms.

Departing from the uninterrupted practice of centuries, he called a Great Council consisting of Lords alone. But the Lords were too prudent to assume the unconstitutional functions with which he wished to invest them. Without money, without credit, without authority even in his own camp, he yielded to the pressure of necessity. The Houses were convoked; and the elections proved that, since the spring, the distrust and hatred with which the government was regarded had made fearful progress.

In November, 1640, met that renowned Parliament which, in spite of many errors and disasters, is justly entitled to the reverence and gratitude of all who, in any part of the world, enjoy the blessings of constitutional government.

The Long Parliament

During the year which followed, no very important division of opinion appeared in the Houses. The civil and ecclesiastical administration had, through a period of nearly twelve years, been so oppressive and so unconstitutional that even those classes of which the inclinations are generally on the side of order and authority were eager to promote popular reforms, and to bring the instruments of tyranny to justice.

It was enacted that no interval of more than three years should ever elapse between Parliament and Parliament, and that, if writs under the Great Seal were not issued at the proper time, the returning officers should, without such writs, call the constituent bodies together for the choice of representatives. The Star Chamber, the High Commission, the Council of York were swept away. Men who, after suffering cruel mutilations, had been confined in remote dungeons, regained their liberty.

On the chief ministers of the crown the vengeance of the nation was unsparingly wreaked. The Lord Keeper, the Primate, the Lord Lieutenant were impeached. Finch saved himself by flight. Laud was flung into the Tower. Strafford was put to death by act of attainder. On the day on which this act passed, the King gave his assent to a law by which he bound himself not to adjourn, prorogue, or dissolve the existing Parliament without its own consent.

After ten months of assiduous toil, the Houses, in September, 1641, adjourned for a short vacation; and the King visited Scotland. He with difficulty pacified that kingdom by consenting, not only to relinquish his plans of ecclesiastical reform, but even to pass, with a very bad grace, an act declaring that episcopacy was contrary to the Word of God.

The recess of the English Parliament lasted six weeks. The day on which the Houses met again is one of the most remarkable epochs in our history. From that day dates the corporate existence of the two great parties which have ever since alternately governed the country.

In one sense, indeed, the distinction which then became obvious had always existed, and always must exist. Not only in politics but in literature, in art, in science, in surgery and mechanics, in navigation and agriculture, nay, even in mathematics, we find this distinction. Everywhere there is a class of men who cling with fondness to whatever is ancient, and who, even when convinced by overpowering reasons that innovation would be beneficial, consent to it with many misgivings and forebodings. We find also everywhere another class of men, sanguine in hope, bold in speculation, always pressing forward, quick to discern the imperfections of whatever exists, disposed to think lightly of the risks and inconveniences which attend improvements.

The Great Schism

In the sentiments of both classes there is something to approve. But of both the best specimens will be found not far from the common frontier. The extreme section of one class consists of bigoted dotards: the extreme section of the other consists of shallow and reckless empirics.

There can be no doubt that in our very first Parliaments might have been discerned a body of members anxious to preserve, and a body eager to reform. But, while the sessions of the legislature were short, these bodies did not take definite and permanent forms, array themselves under recognised leaders, or assume distinguishing names, badges, and war cries.

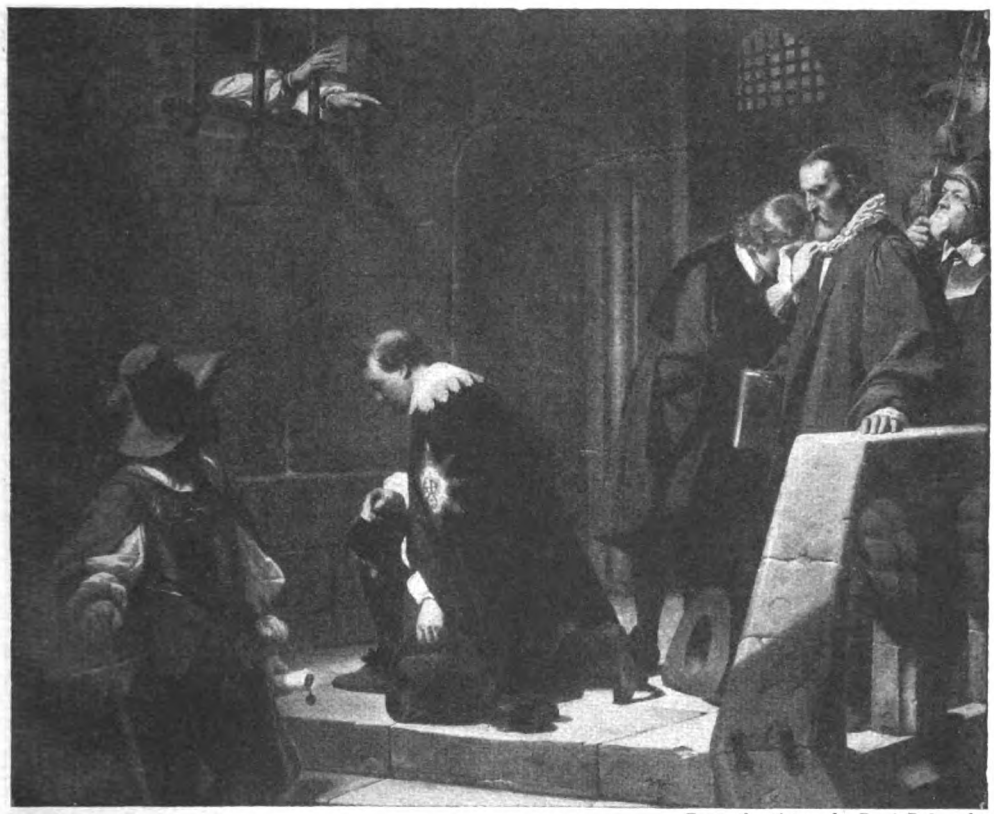
During the first months of the Long Parliament, the indignation excited by many years of lawless oppression was so strong and general that the House of Commons acted as one man. Abuse after abuse disappeared without a struggle. If a small minority of the representative body wished to retain the Star Chamber and the High Commission, that minority, overawed by the enthusiasm and by the numerical superiority of the reformers, contented itself with secretly regretting institutions which could

not, with any hope of success, be openly defended.

At a later period the Royalists found it convenient to antedate the separation between themselves and their opponents, and to attribute the Act which restrained the King from dissolving or proroguing the Parliament, the Triennial Act, the impeachment of the ministers, and the attainder of Strafford, to the faction which afterwards made war on the King. But no artifice could be more disingenuous. Every one of those strong measures was actively promoted by the men who were afterwards foremost among the Cavaliers. No republican spoke of the long misgovernment of Charles more severely than Colepepper. The most remarkable speech in favour of the Triennial Bill was made by Digby. The impeachment of the Lord Keeper was moved by Falkland. The demand that the Lord Lieutenant should be kept close prisoner was made at the bar of the Lords by Hyde.

Not till the law attainting Strafford was proposed did the signs of serious disunion become visible. Even against that law, a law which nothing but extreme necessity could justify, only about sixty members of the House of Commons voted. It is certain that Hyde was not in the minority, and that Falkland not only voted with the majority, but spoke strongly for the bill.

But under this apparent concord a great schism was latent; and when, in October, 1641, the Parliament reassembled after a short recess, two hostile parties, essentially the same with those which, under different names, have ever since contended for the direction of public affairs, appeared confronting each other. During some years they were designated as Cavaliers and Roundheads, and later Tories and Whigs.



From the picture by Paul Delaroche.

THE EARL OF STRAFFORD ON HIS WAY TO EXECUTION

stopped before the cell window of a fellow-prisoner, Archbishop Laud, from whom he received a farewell blessing. Strafford, who on the death of Buckingham became the chief Minister of Charles I., was impeached in 1641 on a general charge of subverting the fundamental laws of the land.

It would not be difficult to compose a lampoon or a panegyric on either of these renowned factions. For no man not utterly destitute of judgment and candour will deny that there are many deep stains on the fame of the party to which he belongs, or that the party to which he is opposed may justly boast of many illustrious names, of many heroic actions, and of many great services rendered to the state.

The truth is that, though both parties have often seriously erred, England could have spared neither. If, in her institutions, freedom and order, the advantages arising from innovation and the advantages arising from prescription have been combined to an extent elsewhere unknown, we may attribute this happy peculiarity to the strenuous conflicts and alternate victories of two rival confederacies of statesmen, a confederacy zealous for authority and antiquity, and a confederacy zealous for liberty and progress.

Royalist Party

It ought to be remembered that the difference between the two great sections of English politicians has always been a difference rather of degree than of principle.

There were certain limits on the right and on the left, which were very rarely overstepped. A few enthusiasts on one side were ready to lay all our laws and franchises at the feet of our Kings. A few enthusiasts on the other side were bent on pursuing, through endless civil troubles, their darling phantom of a republic. But the great majority of those who fought for the crown were averse to despotism ; and the great majority of the champions of popular rights were averse to anarchy. Twice, in the course of the seventeenth century, the two parties suspended their dissensions, and united their strength in a common cause. Their first coalition restored hereditary monarchy. Their second coalition rescued constitutional freedom.

It is also to be noted that these two parties have never been the whole nation, nay, that they have never, taken together, made up a majority of the nation. Between them has always been a great mass which has not steadfastly adhered to either, which has sometimes remained inertly neutral, and which has sometimes oscillated to and fro. That mass has more than once passed in a few years from one extreme to the other, and back again. Sometimes it has changed sides, merely because it was tired of supporting the same men, sometimes because it was dismayed by its own excesses, sometimes because it had expected impossibilities, and had been disappointed. But, whenever it has leaned with its whole weight in either direction, that weight has, for the time, been irresistible.

When the rival parties first appeared in a distinct form, they seemed to be not unequally matched. On the side of the government was a large majority of the nobles and of those opulent and well-descended gentlemen to whom nothing was wanting of nobility but the name. These, with the dependents whose support they could command, were no small power in the state.

On the same side were the great body of the clergy, both the Universities, and all those laymen who were strongly attached to episcopal government and to the Anglican ritual. These respectable classes found themselves in the company of some allies much less decorous than themselves. The Puritan austerity drove to the King's faction all who made pleasure their business, who affected gallantry, splendour of dress, or taste in the lighter arts.

Strength of the Opposition

With these went all who lived by amusing the leisure of others, from the painter and the comic poet, down to the rope-dancer and the merry-andrew. For these artists well knew that they might thrive under a superb and luxurious despotism, but must starve under the rigid rule of the precisians. In the same interest were the Roman Catholics to a man. The Queen, a daughter of France, was of their own faith. Her husband was known to be strongly attached to her, and not a little in awe of her. Though undoubtedly a Protestant on conviction, he regarded the professors of the old religion with no ill-will, and would gladly have granted them a much larger toleration than he was disposed to concede to the Presbyterians.

If the opposition obtained the mastery it was probable that the sanguinary laws enacted against Papists, in the reign of Elizabeth, would be severely enforced. The Roman Catholics were therefore induced by the strongest motives to espouse the cause of the court. They in general acted with a caution which brought on them the reproach of cowardice and lukewarmness : but it is probable that, in maintaining great reserve, they consulted the King's interest as well as their own. It was not for his service that they should be conspicuous among his friends.

The main strength of the opposition lay

among the small freeholders in the country, and among the merchants and shopkeepery of the towns. But these were headed by a formidable minority of the aristocracy, a minority which included the rich and powerful Earls of Northumberland, Bedford, Warwick, Stamford, and Essex, and several other Lords of great wealth and influence.

In the same ranks was found the whole body of Protestant Nonconformists, and most of those members of the Established Church who still adhered to the Calvinistic opinions which, forty years before, had been generally held by the prelate and clergy. The municipal corporations took, with few exceptions, the same side. In the House of Commons the opposition preponderated, but not very decidedly.

Affairs in Ireland

Neither party wanted strong arguments for the course which it was disposed to take. The reasonings of the most enlightened Royalists may be summed up thus :—" It is true that great abuses have existed ; but they have been redressed. It is true that precious rights have been invaded ; but they have been vindicated and surrounded with new securities. The sittings of the Estates of the realm have been, in defiance of all precedent and of the spirit of the constitution, intermitted during eleven years ; but it has now been provided that henceforth three years shall never elapse without a Parliament.

" The Star Chamber, the High Commission, the Council of York, oppressed and plundered us ; but those hateful courts have now ceased to exist. It is time to take heed that we do not so pursue our victory over despotism as to run into anarchy. Henceforth it will be our wisdom to look with jealousy on schemes of innovation, and to guard from encroachment all the prerogatives with which the law has, for the public good, armed the sovereign."

Such were the views of those men of whom the excellent Falkland may be regarded as the leader. It was contended on the other side with not less force, by men of not less ability and virtue, that the safety which the liberties of the English people enjoyed was rather apparent than real, and that the arbitrary projects of the Court would be resumed as soon as the vigilance of the Commons was relaxed. True it was—such was the reasoning of Pym, of Hollis, and of Hampden—that many good laws had been passed : but, if good laws had been sufficient to restrain the King, his subjects would have had little reason ever to complain of his administration.

The recent statutes were surely not of more authority than the Great Charter or the Petition of Right. Yet neither the Great Charter, hallowed by the veneration of four centuries, nor the Petition of Right, sanctioned, after mature reflection, and for valuable consideration, by Charles himself, had been found effectual for the protection of the people. If once the check of fear were withdrawn, if once the spirit of opposition were suffered to slumber, all the securities for English freedom resolved themselves into a single one, the royal word ; and it had been proved by a long and severe experience that the royal word could not be trusted.

The two parties were still regarding each other with cautious hostility, and had not yet measured their strength, when news arrived which inflamed the passions and confirmed the opinions of both. The great chieftains of Ulster, who, at the time of the accession of James, had, after a long struggle, submitted to the royal authority, had not long brooked the humiliation of dependence. They had conspired against the English government, and had been attainted of treason. Their immense domains had been forfeited to the crown, and had soon been peopled by thousands of English and Scotch emigrants. The new settlers were, in civilisation and intelligence, far superior to the native population, and sometimes abused their superiority. The animosity produced by difference of race was increased by difference of religion.

War in Ulster

Under the iron rule of Wentworth scarcely a murmur was heard : but, when that strong pressure was withdrawn, when Scotland had set the example of successful resistance, when England was distracted by internal quarrels, the smothered rage of the Irish broke forth into acts of fearful violence. On a sudden, the aboriginal population rose on the colonists. A war, to which national and theological hatred gave a character of peculiar ferocity, desolated Ulster, and spread to the neighbouring provinces. The Castle of Dublin was scarcely thought secure. Every post brought to London exaggerated accounts of outrages which, without any exaggeration, were sufficient to move pity and horror.

These evil tidings roused to the height the zeal of both the great parties which were marshalled against each other at Westminster. The Royalists maintained that it was the first duty of every good Englishman and Protestant, at such a crisis, to strengthen the hand of the sovereign. To the opposition

it seemed that there were now stronger reasons than ever for thwarting and restraining him.

That the commonwealth was in danger was undoubtedly a good reason for giving large powers to a trustworthy magistrate: but it was a good reason for taking away powers from a magistrate who was at heart a public enemy.

To raise a great army had always been the King's first object. A great army must now be raised. It was to be feared that, unless some new securities were devised, the forces levied for the reduction of Ireland would be employed against the liberties of England.

Nor was this all. A horrible suspicion, unjust indeed, but not altogether unnatural, had arisen in many minds. The Queen was an avowed Roman Catholic: the King was not regarded by the Puritans, whom he had mercilessly persecuted, as a sincere Protestant; and so notorious was his duplicity, that there was no treachery of which his subjects might not, with some show of reason, believe him capable. It was soon whispered that the rebellion of the Roman Catholics of Ulster was part of a vast work of darkness which had been planned at Whitehall.

Parliamentary Conflict

After some weeks of prelude, the first great parliamentary conflict between the parties which have ever since contended for the government of the nation took place on November 22, 1641. It was moved by the opposition, that the House of Commons should present to the King a remonstance, enumerating the faults of his administration from the time of his accession, and expressing the distrust with which his policy was still regarded by his people. That assembly, which a few months before had been unanimous in calling for the reform of abuses, was now divided into two fierce and eager factions of nearly equal strength. After a hot debate of many hours, the remonstrance was carried by only eleven votes.

The result of this struggle was highly favourable to the conservative party. It could not be doubted that only some great indiscretion could prevent them from shortly obtaining the predominance in the Lower House. The Upper House was already their own. Nothing was wanting to ensure their success but that the King should, in all his conduct, show respect for the laws and scrupulous good faith towards his subjects.

His first measures promised well. He had, it seemed, at last discovered that an entire change of system was necessary, and had wisely made up his mind to what could no longer be avoided. He declared his determination to govern in harmony with the Commons, and, for that end, to call to his councils men in whose talents and character the Commons might place confidence. Nor was the selection ill made. Falkland, Hyde, and Colepepper, all three distinguished by the part which they had taken in reforming abuses and in punishing evil ministers, were invited to become the confidential advisers of the Crown, and were solemnly assured by Charles that he would take no steps in any way affecting the Lower House of Parliament without their privity.

The King's Folly

Had he kept this promise, it cannot be doubted that the reaction which was already in progress would very soon have become quite as strong as the most respectable Royalists would have desired. Already the violent members of the opposition had begun to despair of the fortunes of their party, to tremble for their own safety, and to talk of selling their estates and emigrating to America. That the fair prospects which had begun to open before the King were suddenly overcast, that his life was darkened by adversity, and at length shortened by violence, is to be attributed to his own faithlessness and contempt of law.

The truth seems to be that he detested both the parties into which the House of Commons was divided. The advisers whom necessity had compelled him to call round him were by no means men after his own heart. They would have recoiled with horror from the thought of reviving Wentworth's projects of Thorough. They were, therefore, in the King's opinion, traitors, who differed only in the degree of their seditious malignity from Pym and Hampden.

He accordingly, a few days after he had promised the chiefs of the constitutional Royalists that no step of importance should be taken without their knowledge, formed a resolution the most momentous of his whole life, carefully concealed that resolution from them, and executed it in a manner which overwhelmed them with shame and dismay. He sent the Attorney General to impeach Pym, Hollis, Hampden, and other members of the House of Commons of high treason at the bar of the House of Lords. Not content with this flagrant violation of the Great Charter, he went in person, accompanied by armed men, to seize the leaders of the opposition within the walls of Parliament.

From the picture by Ford Madox Brown: by permission of J. Hollyer, Esq.

CROMWELL ON HIS FARM

at St. Ives, near Huntingdon—the constituency which he represented when in 1628 he was returned for the first time to Parliament. In 1631 he sold his Huntingdon property and with the proceeds stocked a farm which he had rented between St. Ives and the Ouse. Leases and other records relating to this farm are still in existence.

The attempt failed.

The accused members had left the House a short time before Charles entered it. A sudden and violent revulsion of feeling, both in the Parliament and in the country, followed. The most favourable view that has ever been taken of the King's conduct on this occasion by his most partial advocates is that he had weakly suffered himself to be hurried into a gross indiscretion by the evil counsels of his wife and of his courtiers.

At the very moment at which his subjects, after a long estrangement produced by his maladministration, were returning to him with feelings of confidence, he had aimed a deadly blow at all their dearest rights.

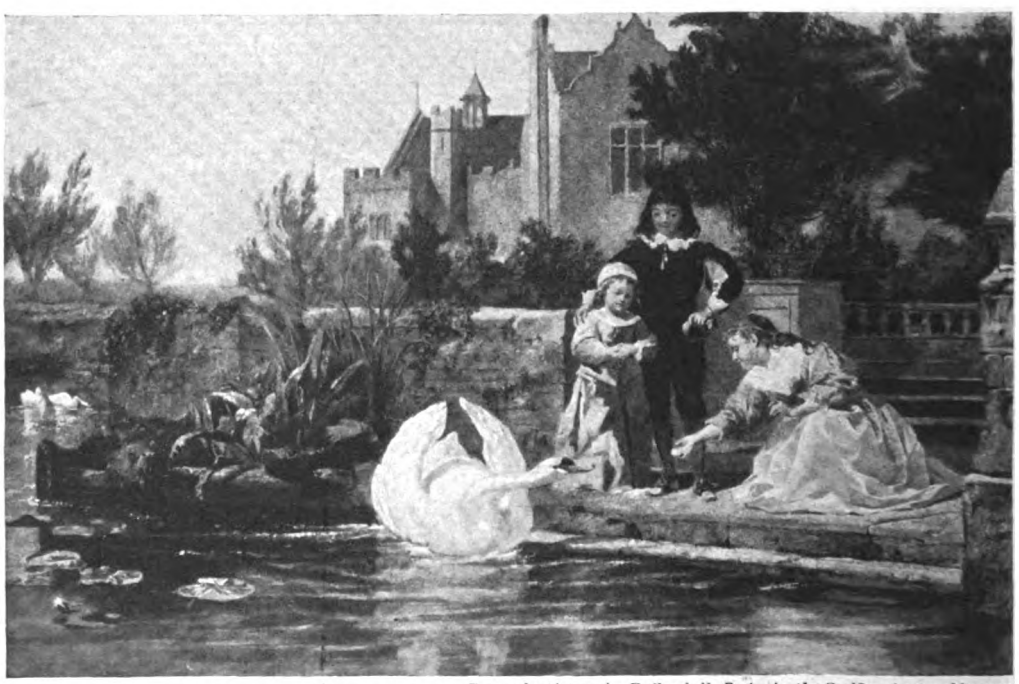
London in Arms

He had shown that he considered opposition to his designs as a crime to be expiated only by blood. He had broken faith, not only with his Great Council and with his people, but with his own adherents. He had done what, but for an unforeseen accident, would probably have produced a bloody conflict round the Speaker's chair.

Those who had the chief sway in the Lower House now felt that not only their power and popularity, but their lands and their necks, were staked on the event of the struggle in which they were engaged. The flagging zeal of the party opposed to the court revived in an instant. During the night which followed the outrage the whole city of London was in arms. In a few hours the roads leading to the capital were covered with multitudes of yeomen spurring hard to Westminster with the badges of the parliamentary cause in their hats.

Unprecedented Violence

In the House of Commons the opposition became at once irresistible, and carried, by more than two votes to one, resolutions of unprecedented violence. Strong bodies of the trainbands, regularly relieved, mounted guard round Westminster Hall. The gates of the King's Palace were daily besieged by a furious multitude whose taunts and execrations were heard even in the presence-chamber. Had Charles remained much longer in his stormy capital, it is probable that the Commons would have found a plea for making him a State prisoner.



From the picture by F. Goodall, R.A., in the S. Kensington Museum.

THE CHILDREN OF CHARLES I.

at Hever Castle, Kent, in the happy days before the differences between the King and his Parliament threw the country into a state of war. Princess Mary (later Princess of Orange and mother of William III.) is seen trying to entice a swan, while the future Charles II. and Princess Elizabeth—who, it is said, died of grief at Carisbrooke Castle after the execution of her father—are seen looking on.

Continued from page 278.

SCIENCES:

Contributors:—ANTHROPOLOGY AND ETHNOLOGY (Sir H. H. Johnston, G.C.M.G., K.C.B.). ASTRONOMY (Arthur R. Hinks, M.A., F.R.S.). BOTANY (E. W. Edmunds, M.A., B.Sc.[Lond.]). CHEMISTRY (E. H. Tripp, Ph.D.). ELECTRICITY AND MAGNETISM (L. M. Parsons, M.Sc., D.I.C., F.G.S.). GEOLOGY AND MINERALOGY (Arthur Holmes, D.Sc. [Lond.], A.R.C.S., D.I.C., F.G.S.). PHYSIOLOGY (Sir Malcolm Morris, K.C.V.O., and D. W. Carmalt-Jones, M.A., M.D.[Oxon.]). SOUND, LIGHT, AND HEAT (E. W. Edmunds, M.A., B.Sc. [Lond.]). ZOOLOGY (E. A. Bryant and Ashley G. Brown, F.Z.S.).

BOTANY.—XI

30. Buds (Continued).—Most buds show a greater specialisation, especially on the outer leaves, than does the Cabbage-sprout. In a Horse-Chestnut bud, for example, we can observe three kinds of structures. Outwardly we have a series of dry scales, not leaflike at all, overlapping one another partially like the tiles on a roof and cemented together with resin. Obviously these *outer scales* are purely protective in function.

Removing these we come to two thin green scales which together completely envelop the inner portion of the bud. This consists of four, six or even more, true leaves and possibly an inflorescence. The leaves are covered with down, but are of the same shape as the mature leaves and, like them, are oppositely arranged.

These leaves and the growing point within them have thus a three-fold protection; the fine down, the inner scales and

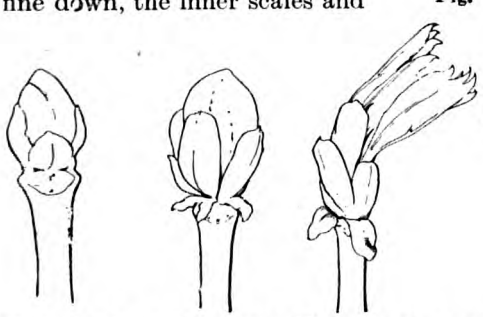


Fig. 60.—Buds of a Horse-Chestnut—four stages.

the resinous outer scales. At the opening of the bud, which should be very carefully observed, the internodes between the true leaves lengthen; the leaves themselves swell and expand; while the scales are merely pressed back and drop off when they cease to be useful, leaving the close cluster of bud-scale scars to mark their place (Fig. 60).

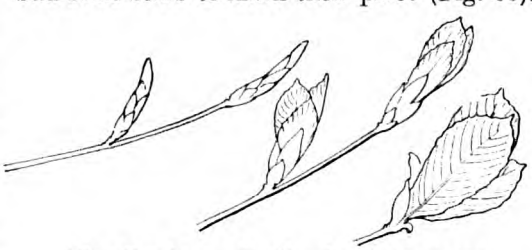


Fig. 61.—Buds of a Beech—three stages of development.

The leaves in the bud have to be compactly folded by reasons of space; and the method of folding, or *vernation*, varies a good deal.

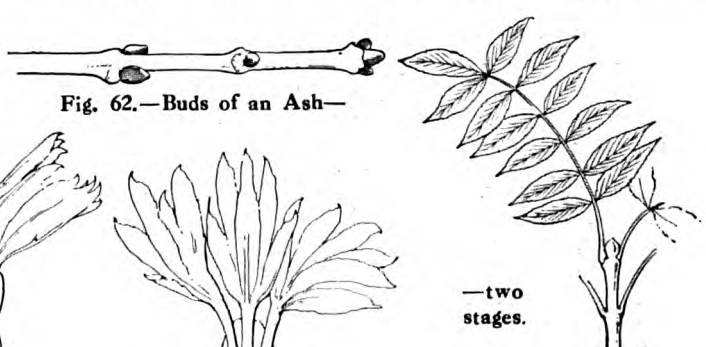


Fig. 62.—Buds of an Ash—two stages.

It may be *conduplicate*, folded once on the midrib (Elm); *involute*, with the edges of the leaf turned inwards (Poplar); *revolute*, with the edges turned backwards (Plane);

plicate, or pleated (Horse-Chestnut); *convolute*, rolled up round the midrib (Blackthorn); *crumpled*, folded irregularly.

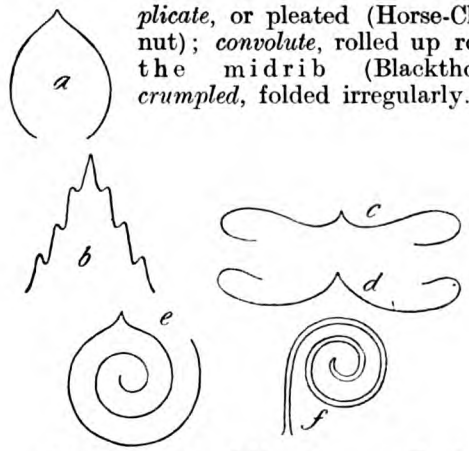


Fig. 63.—Types of Vernation. *a*, **Conduplicate**; *b*, **Plicate**; *c*, **Involute**; *d*, **Revolute**; *e*, **Convolute**; *f*, **Circinate.**

The advantages of these different plans will appear when each individual bud is studied. In the pinnate leaf of some ferns, the simplest arrangement possible is seen. The leaf is merely rolled up into a circle, and protected only by scales on its outer surface (Fig. 63 *f*).

The morphological nature of the outer scales is not always the same. In the

Fig. 64.—Three Bud Scales of Flowering Currant. *b*, **Leaf base.**

Guelder Rose there are none. Those of the Lilac are clearly ordinary leaves, which remain green and are only different from the inner leaves in being tougher and harder. In the Horse-Chestnut they do not resemble the true leaves in any way.

Careful study shows that the scales are, in fact, the enlarged leaf-bases of leaves whose petiole and lamina have not developed. Some of the inner scales often show the rudiments of the lamina attached to the top (Fig. 64).

Fig. 65.—Showing the Auxiliary Bud of a Wayfaring Tree.

In the Flowering Currant the transition from leaf-base with rudimentary lamina to full lamina and small leaf-base is well-marked through the series of scales. In the Beech, it is equally clear that the scales are but modified stipules. Some of the true leaves have small stipules subtending them, which remain for a time while the bud opens; as we proceed outwards the stipules gradually become more prominent, till in the outer scales nothing else is present.

The elaborate arrangement of scales is a very efficient protection for the bud, but it is not necessary in all cases. The flower-buds of transitory shoots, which only appear above ground in warm weather, do not need so much care. Nevertheless, we find in many of these cases that the bud is sheltered, perhaps by being ensconced in an expanded or hollowed petiole; or perhaps by a sheathing leaf-base (i.e. in Hogweed); or perhaps by a sheathing or enlarged stipule (e.g. in Dock or Knotgrass, in which the stipules form a sheathing tube or *ochrea*.

It is an instructive exercise to make a plan, similar to Fig. 66, in order to show the arrangement of the constituent parts of a bud. It expands what would be seen in a transverse section of the bud; it is not, however, easy to represent on it the details of flowers, and the student should study flower-buds more minutely at a later stage.

Carefully examine the external appearance of some of the following buds; examine the morphological nature of the scales; define the vernation of the leaves; and draw a plan:—Ash, Elm, Sycamore, Hazel, Elder, Rose, Apple and Lime.

31. Bulbs.—Resting buds, such as those with which we have just been dealing, are small structures, drawing the food-supply needed to carry them over the first stages of their development from the general store of the plant. Those plants which have bulbs, however, represent exactly the opposite character.

Fig. 66.—Plan of Bud of Black Poplar.

The bulb is no more than a very large bud on a very much reduced stem. A bulbous plant is a perennial which does not, like trees, increase in size from year to year, but provides only for a multiplied repetition of itself. The bulb produces its leaves and flowers, which die down, leaving several new bulbs, each of which will repeat the tale next year. The new plants thus obtained are in reality no more than branches of the old one; still they are separate individuals, and give us our first example of *vegetative repro-*

duction, i.e. the production of new individuals without any fertilising process.

Cut through a Hyacinth bulb lengthwise in the median plane. In the centre will be noticed the inflorescence, surrounded by several true leaves, all being wrapped up in two or three green scale leaves which play the part of the inner scales of the Horse-Chestnut bud. Outside these are several concentric fleshy scales, in which the food-material (sugar) is stored. These are covered completely with true dry scales; and the whole rests upon a solid flat disc, which is all that survives of the stem.

In the axils of some few of the scales, careful search will reveal small lateral buds, which will produce the new bulbs.

The Hyacinth should be compared with other bulbs, like the Onion, Narcissus, Lily or Tulip.

The development of a Hyacinth or other bulb can be easily watched by placing it on a glass vase, so that the base of the stem just touches the surface of water. The first change, which is noticeable in a very short time, is the development of a ring of adventitious roots from the outer rim of the base of the bulb. Water can now be absorbed, and the subsequent development is very like that of a bud. The leaves swell and their tips begin to protrude through the apex of the bulb. Soon they spread out, pushing the scales aside; the flower axis then elongates, and in a few days the whole inflorescence, as well as the leaves, has completely emerged from the bulb.

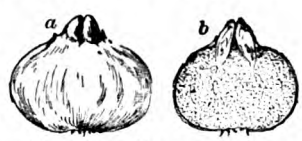


Fig. 67.—Crocus Corm. *a*, General appearance; *b*, Section.

Meanwhile the scales are losing their contents, and the bulb will often slip into the vase owing to its diminished size. The fully-grown leaves, however, can now feed the plant; and when the flowers have died off, the leaves, which continue for some time longer, make the sugar which is necessary for the new bulbs. In a vase, these are neither numerous nor large; but under ordinary circumstances they attain the size of the original, and there may be three or more of them, according to the conditions of nutrition.

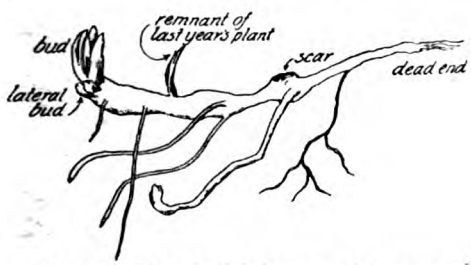


Fig. 68.—Branched Rhizome of Perennial Sunflower.

The Narcissus or Daffodil, differing from the Hyacinth in one or two particulars, should also be grown.

Watching its development, we may note that its fleshy scales are the enlarged leaf-bases of the leaves of the previous year; moreover, the Narcissus bulb is formed monopodially, from the main axis, not sympodially, as lateral axes, as in the Hyacinth.

The *corm* of the Crocus or Arum differs from a bulb in having no fleshy scales around the bud. It consists chiefly of a solid mass of starch, which is the shortened and swollen stem, with one or more buds partly embedded in it (Fig. 67). Each bud has its covering of thin brown scale; similar but independent membranous scales also cover the corm itself. Each bud shows an immature flower in which the parts are clearly recognisable; outside the flower are the foliage leaves, and the whole is completely enveloped in two light brown scale-leaves.

Fig. 69.—Bulb of a Lily in November, and—

—in February.

Development begins, as in the case of most bulbous plants, early in the spring. The flower opens first and dies early, while the leaves remain quite late into the summer. At first the corm becomes flaccid and dark-coloured, but its contents are rarely exhausted entirely, and at the end of the summer the old corm often remains attached to the new one which has been formed. One corm only develops at the base of each bud.

32. Underground Stems.—Some perennials store up food in portions of the stem which remain underground. Examples of this are to be found in the *rhizomes* of such plants as the Iris, and the *tuber* of the Potato.

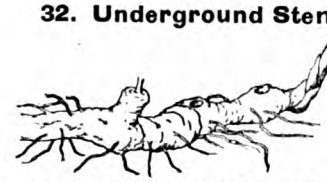


Fig. 70.—Rhizome of Solomon's Seal.

The rhizome is an underground stem which generally takes a more or less horizontal course, though it is nearly erect in the so-called *root-stocks* of such plants as the Primrose.

The elongation of the rhizome is provided for by a lateral bud in the axils of one of the

scales at the terminal bud, so that the rhizome is generally a sympodium. It is easy to see from the budding and branching of its rhizome why the perennial Sunflower persists; why it spreads so widely; and why it is difficult to eradicate. For a very small piece of the rhizome will, so long as it contains a bud, start a new plant.

The rhizomes of Iris and Solomon's Seal are comparatively short and stout. The latter is especially instructive because all the features of a rhizome are conspicuous on it. Particularly we may notice the very plain scars left on the rhizome by the decay of the overground shoot. The year's addition to the main rhizome can be easily marked off.

Many other plants have rhizomes—Lily of the Valley, Wood Anemone, Jerusalem Artichoke, some grasses, bracken, etc. Most of them are early-flowering, and grow best in an exceptionally light and loose soil, on account of the difficulty of pushing a way for so thick a structure through close and heavy ground. The terminal bud is pointed, curved, and covered with tough scales.

The *tuber* of the Potato is a swollen underground stem-branch, stored with a large food-reserve, consisting chiefly of starch, with a small amount of protein immediately beneath the skin. The skin is pierced with lenticels, and dotted over with "eyes." These, on examination, are found to be small lateral buds each covered with a leaf-scale. If the Potato be kept damp, and in a warm place in the dark, it begins to sprout; i.e. long slender branches arise from the "eyes." On these branches new Potato plants will arise, with their aerial shoots and underground stems. E. W. E.

ANATOMY AND PHYSIOLOGY. VI

We have now seen the body as a machine for doing work. It consists of levers, the bones, which are attached to one another by joints, the joints are moved by muscles, and the muscles are controlled by nerves.

The supply and distribution of food and air, and the removal of waste, which as we saw on p. 20 are necessary to the working of the machine, are managed by the internal organs, contained in the trunk.

The trunk is hollow, and is divided into two compartments, the chest or *thorax* above, and the belly or *abdomen* below. The two are separated by a dome-shaped sheet of muscle called the diaphragm.

The chest is quite enclosed by the ribs; the upper part of the belly is also partly protected by ribs.

The skeleton of the chest consists of the twelve dorsal vertebræ, the ribs with their cartilages, and the breast-bone. The ribs curve forwards from the spine, and their cartilages are joined on to the sternum or breast-bone, which is a flat bone about two inches broad, and runs down the front of the chest. The ribs slope downwards behind, and upwards in front. The cartilages of the upper six join directly on to the sternum. Those of the next four close up with one another without actually touching the sternum, and the last two are floating and do not join any other ribs. The chest thus forms a bony basket by which the important organs it contains are protected.

The spaces between the ribs are filled with muscles which join the ribs together, known as the *intercostal* muscles; there are two layers of them, outer and inner. They are concerned in breathing.

Internal Organs

The diaphragm, the chief breathing muscle, forms a dome. It is attached all round the lower edge of the ribs inside and to the fronts of the lumbar vertebræ. From this attachment the fibres rise up and arch over the top of the abdomen, forming the dome. The crown of the dome is a patch of tendon into which these fibres are inserted. When the muscle contracts the whole dome is drawn down, and partly flattened. Outside the ribs and intercostal muscles are the shoulder-blade behind, and also the great muscles moving the arm, the pectoralis, latissimus dorsi, and trapezius already described, and others.

To examine the thorax and its contents, a long cut is made through the skin down the middle of the chest and belly. The skin is raised and dissected off the parts below, and turned back, the rib cartilages are then cut through, and the breast-bone removed.

The cavity of the chest is then exposed. In the middle and inclining to the left is the *heart;* on each side of it are the *lungs*. These are the chief viscera of the *thorax*.

The heart lies inside a fibrous bag, the *pericardium*. When this is cut open, the heart is seen inside. The pericardium is lined by a smooth membrane, and the heart is covered with a similar smooth covering.

Between the two is a little lubricating fluid. This corresponds exactly to the smooth-turned surfaces of machinery which

have to move inside one another and require to be oiled. The heart moves and changes its shape, and the pericardium provides a smooth surface to prevent friction.

in the front and passes back and to the left, and the artery then runs down the body to the left of the vertebræ. It leaves the thorax by passing through the diaphragm

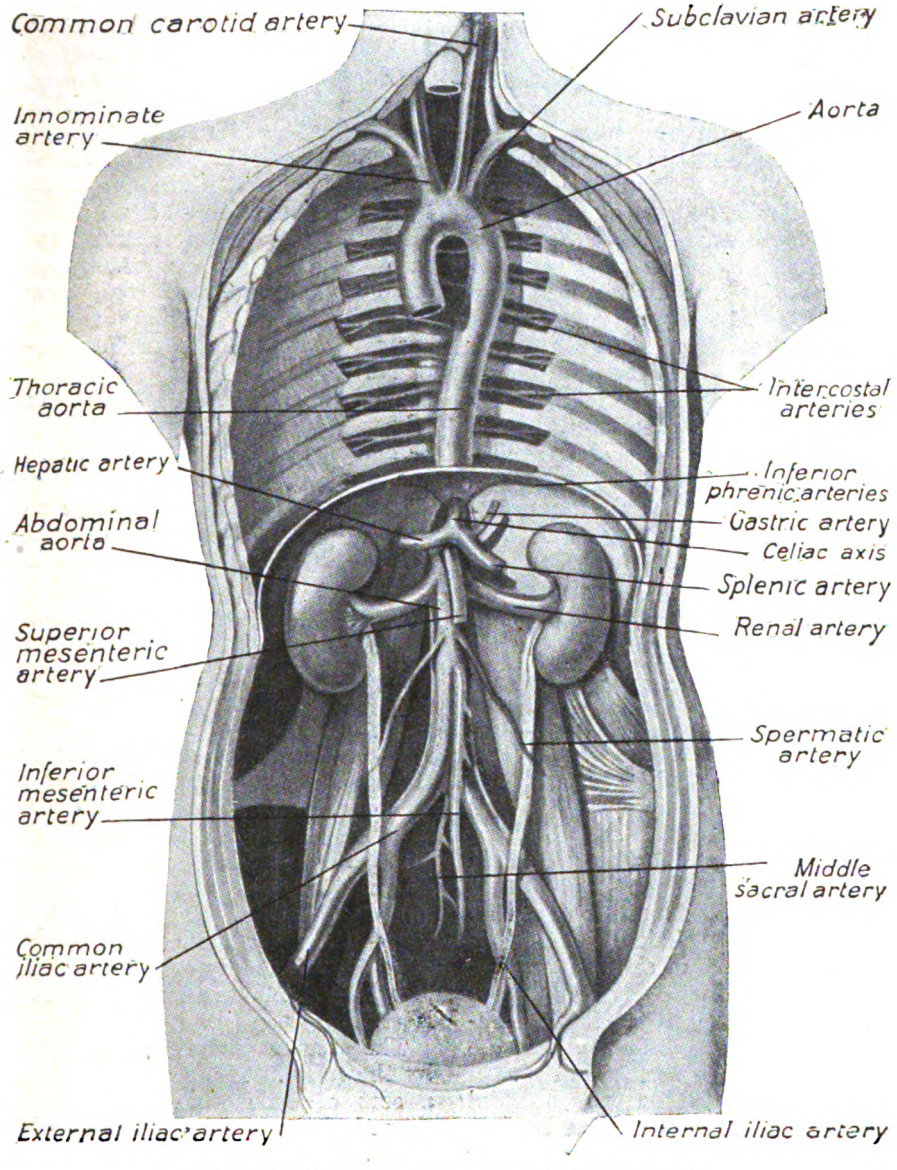


DIAGRAM SHOWING THE PRINCIPAL ARTERIES.

The heart is about the size of the closed fist. It has rather the shape of a cocoa-nut. It lies on its side on the diaphragm, and its point lies towards the left. From the upper side of its broad end comes out the great vessel which carries blood all over the body, called the aorta. This great artery forms an arch in the chest. The arch rises

into the abdomen, where it runs for some distance along the spine and then divides opposite the fourth lumbar vertebra into two great branches, one for each leg, the *common iliac arteries*.

The whole body, except the lungs, gets blood from the aorta, or its branches. The chief branches in the chest are three, the

innominate, a short stout vessel which rises from the arch and soon divides into two, called the *right common carotid artery* and the *right subclavian artery.*

A little way beyond the innominate two others, the left common carotid and the subclavian, arise. The carotid arteries supply the head and neck, the subclavians supply the arms. "Subclavian" means "under the collar-bone." On the right these two come off in one trunk from the aorta, which afterwards divides; on the left they each arise separately.

The carotid arteries run up the neck in a similar position on each side. They give off many branches for the parts in the neighbourhood and divide into the external and internal carotid. The branches of the external carotid are the chief blood supply of the face. The internal carotid enters the skull through a hole in the base, and is one of the chief supplies of the brain.

The brain is also supplied by a branch from the subclavian called the *vertebral,* which runs up the neck and enters the skull through the foramen magnum.

Vertebral Arteries

The two vertebral arteries, right and left, join together inside the skull to form one trunk, the *basilar artery,* which runs forwards along the base of the skull inside for a short distance and then divides again into two branches, the right and left posterior cerebrals, for the back of the brain. The internal carotid divides into two branches, the anterior and middle cerebral, for the front and mid-part of the brain. Branches from the internal carotid join the basilar, so that there is a circle of vessels under the base of the brain called the "circle of Willis."

The subclavian is part of an artery which runs from the neck to the bend of the elbow, giving off branches all the way. In the armpit it is called the *axillary* artery, and in the upper arm it is called the *brachial* artery.

At the bend of the elbow, the brachial artery divides into the *radial* and *ulnar* arteries, which run down the outer and inner sides of the forearm respectively, and in the hand join together again to form the "palmar arch." Branches from this arch run forwards to each of the fingers.

In the abdomen, the aorta gives off important branches for the stomach and intestines, the kidneys and neighbouring parts, before ending in the common iliac arteries.

The common iliacs soon divide into the *external and internal iliacs.* The internal iliac supplies the viscera of the pelvis, and also the inner side of the thigh. The external iliac is the upper end of a large vessel which supplies the leg. It passes out of the abdomen over the pubic bone; on the inner side of the femur, it runs down the thigh and passes backwards to the back of the knee and leg, where it divides into two.

On the front of the thigh it is called the *femoral,* and behind the knee it is called the *popliteal.* Near its end it gives off a branch called the *anterior tibial artery* for the shin, and its two final divisions are the *posterior tibial* on the inside and the *peroneal* on the outside. The posterior tibial is continued into the foot as the *external plantar* and supplies the sole and toes, but the back of the foot and toes are supplied by the *dorsalis pedis,* a continuation of the anterior tibial.

The veins generally accompany the arteries; where you find a large artery you find a vein along with it. In addition, there are the numerous surface veins, like those on the backs of the hands and on the arms. These generally join the deep veins at last.

Very important veins are the jugular veins which accompany the carotid arteries in the neck. A wound of one of them often leads to bleeding to death.

Veins

The veins are collected together into two great trunks which lead into the heart. These are the *superior vena cava* which brings blood from the head and arms and opens into the right hand end of the heart from above, and the *inferior vena cava* which accompanies the aorta in the abdomen, passes through the diaphragm and opens into the under side of the right-hand end of the heart.

The blood supply of the lungs is arranged in a special manner which will be described later.

The greater part of the chest is taken up by the lungs. The two lungs together form a sort of cone which fill up the conical-shaped chest, and they are arranged one on each side, right and left.

Each lung by itself is a sort of half cone, with a flattish base which stands on the diaphragm, a curved outer side which touches the ribs, and a hollow inner side which faces its fellow, being separated by the heart and great vessels, and the air passages leading from the throat to the lungs.

The thorax is lined by a smooth membrane, the pleura, and there is a similar membrane covering the outside of the lung, so that it can move freely in breathing.

The lungs are of a greyish colour, and very light; they float in water. They contain air and can be squeezed up like a sponge.

How does air get into the lungs? Open your mouth wide and look at it in the glass. You will see at the back of it an arch of fleshy material called the soft palate, in the middle of which is a little projection called the *uvula*. Behind this arch is a passage which runs both upwards and downwards. It is possible to pass your finger through the mouth and up behind the palate, till you reach the base of the skull. The space where your finger is is called the *pharynx*. The nostrils lead back into the pharynx, so when you breathe either through the nose or mouth, the air first passes into the pharynx.

You can also pass your finger downwards and it will pass either into the wind-pipe or into the upper end of the digestive system. Both of these are tubes which start at the bottom of the pharynx. The wind-pipe is in front and the digestive system behind.

The wind-pipe consists chiefly of cartilage rings, so as to form a flexible tube. Its upper end is the *larynx* ("Adam's apple") in front of the neck, and contains the organ

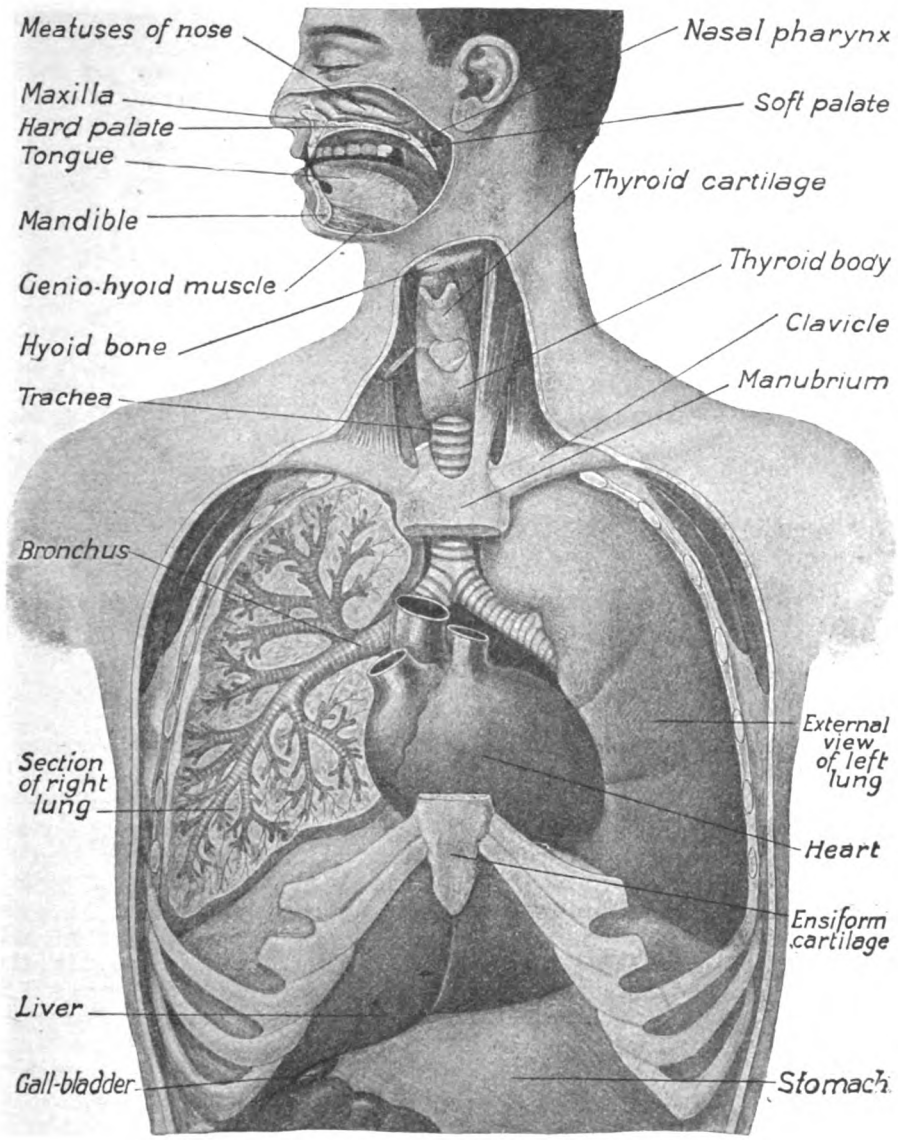


DIAGRAM SHOWING THE RESPIRATORY TRACK.

of voice. Below, it is a single straight tube, the *trachea*, about four inches long, which runs downwards into the middle of the chest. It divides into two branches, right and left, the *bronchi*, one for each lung.

If you examine the lungs you will find running round the outside of the right lung two deep clefts, dividing it into three lobes. The left lung has one cleft and two lobes.

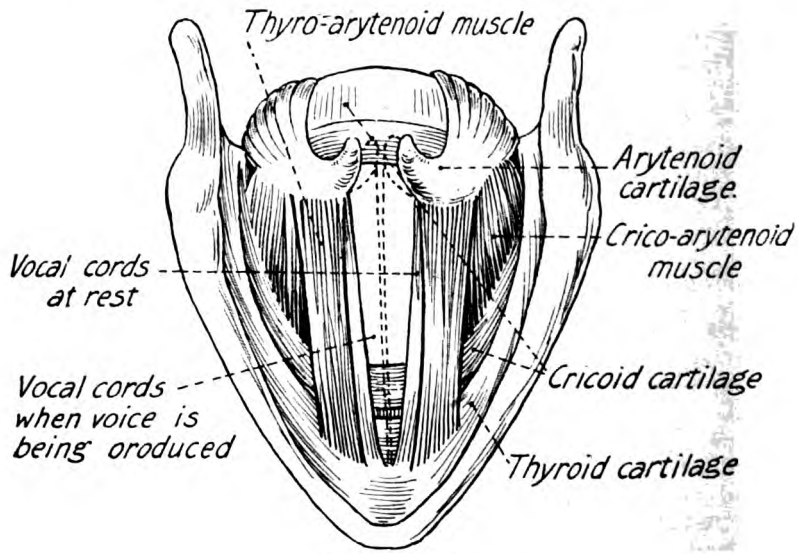
The right bronchus divides into three branches, one for each lobe, and the left bronchus into two. Within their lobes each bronchus divides many times, getting smaller and smaller with each division, and finally each little bronchus ends in a little air balloon which contains the air breathed in.

The respiratory system consists of the nose and mouth, the pharynx, larynx, trachea, bronchi and air balloons, the pleura, the ribs, the spine, the diaphragm and intercostal muscles.

The digestive, or alimentary system consists of a tube which runs from end to end of the trunk, most of it is contained in the abdomen. It begins at the mouth, where food is tasted by the tongue and palate, broken up by the teeth, swallowed into the pharynx and then passed into the alimentary canal proper.

It is passed through the chest as quickly as possible, and the alimentary tube here consists of a stout tube, called the *œsophagus*, which runs straight through the chest from top to bottom, behind the trachea. It passes through the diaphragm, and enters the abdomen. Once past the diaphragm, the tube swells out into a large bag, the *stomach*.

This bag is curved and stretches from left to right, and ends about the middle of the body. Food passes out of the stomach at its right-hand end into a comparatively narrow tube, the *small intestine*. The first few inches of this are called the *duodenum* and are fixed to the back of the abdominal cavity. The rest of the small intestine, the *jejunum* and the *ileum*, can move fairly freely, but its lower end is fixed near the right-hand bottom corner of the abdomen, where it opens into the *large intestine*. The small intestine is about twenty feet long.



THE LARYNX,

or "Adam's Apple," is situate in front of the neck and contains the organ of voice.

The large intestine starts at the right-hand bottom corner of the abdomen and first runs upwards towards the ribs; this part is called the *ascending colon*. It then turns to the left, and runs straight across the body; this part is called the *transverse colon*. From here it runs downwards to the left-hand bottom corner; this part is called the *descending colon*. It then forms a curve, called the *sigmoid flexure*, and ends in a straight piece, the *rectum*, which ends at the back passage or *anus*. The large intestine is about five feet long.

There are two large glands connected with the small intestine, the *liver* and *pancreas*. The liver is a dark brown wedge-shaped mass, which fills the upper right-hand part of the abdomen, the broad end of the wedge is against the ribs, and the thin end over the

stomach. It weighs about three and a half pounds, and is about ten inches long, six inches wide, and three inches thick at its outer end. Its secretion passes by a tube, called the common bile-duct; into the duodenum. Before it is poured out, the secretion collects in a bladder, the *gall-bladder*, on the under side of the liver.

The other gland is called the pancreas, which is a long flat body, lying across the abdomen behind the stomach; its secretion passes by a duct into the duodenum, close to the common bile-duct.

The abdomen is lined by a smooth membrane which is also spread over the contents, stomach, intestines, liver, and so on. It is called the peritoneum. It is so arranged that it allows the intestines to move freely up to a certain point, but yet keeps them attached to the back of the abdomen. It tethers them, and allows them movement without letting them get quite free.

Waste Matter

The alimentary system, then, consists of the mouth, pharynx, œsophagus, stomach, small intestine, large intestine, rectum, anus and peritoneum.

The abdomen itself is a long cavity, rounded above and below. It is bounded above by the diaphragm, behind and at the sides by the lumbar vertebræ and the muscles between the ribs and the ilium, and bounded in front by the muscles running from the forepart of the ribs to the pubes. It is bounded below by the ilium on each side.

The ilium is one of the bones of the pelvic girdle; the space within the actual ring of the girdle is called the pelvis. It is below the abdomen proper. Its lower end is partly closed by muscles, through which pass both the front and the back passages.

Excretion, the getting rid of waste, is done by several organs, partly by the intestines, partly by the lungs, partly by the skin.

The waste materials which contain nitrogen are got rid of by the *kidneys*.

These are two organs, placed in the abdomen, one on each side. They are bean-shaped and are placed one on each side of the spine with the rounded side outwards. Each is about five inches long. When cut open, they are seen to be thick, but hollow; the cavity in the middle is called the pelvis of the kidney. A fibrous and muscular tube called the *ureter* leads out of each *pelvis* and passes down the back of the abdomen and opens into the bladder, a hollow muscular organ placed in the front part of the pelvis.

The water or *urine* is secreted by the kidney, it passes down the ureter, and accumulates in the bladder, from which it is expelled from time to time through another tube, the *urethra*, which leads to the outside through the front passage, which passes through the floor of the pelvis.

The excretory system consists of the kidneys, the ureters, the bladder and the urethra.

The Skin

Finally, the whole body is covered by skin which is both tough and waterproof, and is covered in part with hair. It has many functions. It gets rid of water by sweating. This sweating regulates the heat of the body. Besides this it contains the nerves of feeling, on which we depend for the knowledge of our surroundings.

Besides the skin with its nerves of touch, we have various special senses, the eyes for the perception of light, the ears for the perception of sound, the nose for the perception of smell, and the tongue and palate for the perception of taste.

This concludes a very brief summary of the parts of the human machine for doing muscular work. D. W. C.-J.

MINERALOGY.—III

29. The Determination of Minerals.—A complete quantitative chemical analysis and a determination of the crystalline form suffices to define any mineral species completely. Sometimes, however, the crystal form is not developed; and a quantitative analysis is a long and difficult process which fortunately is only necessary in very special cases.

Generally, the properties which were described in the last lesson, together with a few simple blowpipe reactions, will serve to determine a mineral. The crystal form must, of course, be determined as far as possible, and among the important physical properties to be tested are streak, hardness, and specific gravity.

If a mineral possesses metallic lustre it is probably a metal or the sulphide (or analogous compound) of a metal. Most silicates, carbonates, and sulphates have a vitreous lustre. The chemical examination, made as far as possible by blowpipe reactions, consists of:—

(1) *Dry tests*, in which the powdered mineral is heated in closed and open glass tubes and on charcoal both with and without certain fluxes and reagents; on platinum wire, to test the flame coloration; and in beads of borax, microcosmic salt, and sodium carbonate, to test the colour of the compound so produced.

(2) *Wet tests*, in which the powdered mineral is subjected to the action of acids and other reagents.

30. The Origin of Minerals.—The origin of minerals is naturally wrapped up with the origin of the rocks and ore deposits in which they occur. Little can be said here concerning that difficult subject. It will be sufficient for the present to summarise some of the conditions under which minerals form.

In the list given below it will be seen that there are two main processes of formation under which minerals may conveniently be classified.

I. *Minerals formed by processes originating within the earth.* (*Temperature high.*)

(*a*) By the crystallisation of igneous rock magmas—e.g. quartz, the majority of silicate minerals, pyrite, magnetite, chromite.

(*b*) By the precipitation and chemical activity of gaseous exudations from deep-seated igneous magmas—e.g. cassiterite, fluor, kaolin, topaz, tourmaline, etc.

(*c*) By precipitation from volcanic exudations—e.g. sulphur.

(*d*) By the precipitation and chemical interaction of hot thermal solutions derived from, or heated by, igneous magmas—e.g. sulphide minerals (metalliferous veins), celestite, quartz, opal, calcite, etc.

(*e*) By the metamorphism due to heat, pressure, and chemical activity at considerable depths within the earth—e.g. andalusite, staurolite, garnet, spinel, tremolite, talc, etc.

II. *Minerals formed by processes originating at or near the earth's surface.* (*Temperature normal.*)

(*a*) By decomposition due to weathering. Many oxidised and hydrated minerals—e.g. limonite, bauxite, malachite, anglesite, etc. Clay minerals, such as lithomarge.

(*b*) By deposition and replacement from solution in surface waters—e.g. rock salt, gypsum, chalybite, limonite, calcite, dolomite.

(*c*) By deposition (in veins) and replacement from solution in descending waters—e.g. chalybite, hæmatite, some sulphides.

31. The Description of Minerals.—The remaining part of this course will be mainly occupied with the systematic description of minerals; the classification adopted will be that outlined in Section 16 of the last lesson. As space only allows of a general account being given of a few minerals of outstanding importance, a large number of other minerals are mentioned in the lists which follow, where their composition, crystalline system, hardness (H), specific gravity (Sp. gr.), and streak or colour are tabulated.

I.—NATIVE ELEMENTS

1. Diamond.

Carbon. Cubic, occurring in octahedra. Cleavage, octahedral. Brittle. H = 10. *Sp. gr.* = 3·52. *Transparent. Lustre, adamantine. Insoluble in acids.*

The diamond is the most valuable of precious stones and the hardest of minerals. It is found in river gravels in India, where it was first known; in Brazil, where it was discovered in 1725; and in South Africa, where, in 1867, it was found by accident by some Boer children. A rough diamond is rarely very attractive, but the Indian lapidaries discovered that, in spite of its extreme hardness, it could be polished and ground with its own powder; and in the "brilliant" form, in which it is now cut, its high refraction and brilliant lustre combine to make it the most sparkling and precious of gems. The diamond is also unique in having the simplest composition of all gems, being simply crystallised carbon, a composition which it shares with graphite, the so-called "black lead."

Diamonds, in common with other jewels, are weighed in carats. The carat, unfortunately, is a variable unit, its international value being about 205 milligrams. But in England the unit is now standardised as a metric carat of 200 milligrams, a fifth of a gram. Diamond sometimes occurs as *bort* and *carbonado*, which are brown, grey, or black, and therefore of no use as gems. They are, however, perceptibly harder than the transparent form, and are used for glass-cutting, for cutting, grinding, and polishing rocks and stones, and for boring through solid rocks for mining purposes. Diamond powder is also used for turning the hard steel used in modern armaments.

The largest diamond which has ever been found is the Cullinan, weighing 3,253¾ carats, discovered near Pretoria in 1905. It was cut into two large and a number of small stones, all of which were presented to King Edward VII. and are now in the Royal Regalia.

2. Graphite.

Carbon. Hexagonal, occurring in hexagonal flakes. Cleavage, basal. Pliable. H = 1. *Sp. gr.* = 2. *Opaque. Colour, iron-black. Streak, grey. Lustre, metallic. Insoluble in acids.*

Graphite is one of the softest of minerals, and in this as in many other of its properties it affords a remarkable contrast to diamond. Because of its softness it leaves a mark when rubbed on paper, and owing to this property it is used for pencils, for polishing grates ("black lead"), and for lubricating machinery. It occurs in foliated masses in crystalline schists and limestones, and in veins in association with pegmatites and other igneous rocks.

3. Sulphur

Sulphur. Orthorhombic, occurring in doubly terminated pyramids. Brittle. Fracture, conchoidal. H = 2. *Sp. gr.* = 2. *Transparent to translucent. Colour, sulphur yellow. Streak, white. Lustre, resinous. Volatilises and burns.*

Sulphur is deposited around volcanoes and solfataras, both as a sublimate from volcanic vapours and by the interaction of gases such as sulphur dioxide and hydrogen sulphide, e.g.:

$$2H_2S + SO_2 = 2H_2O + 3S.$$
$$2H_2S + O_2 = 2H_2O + 2S.$$

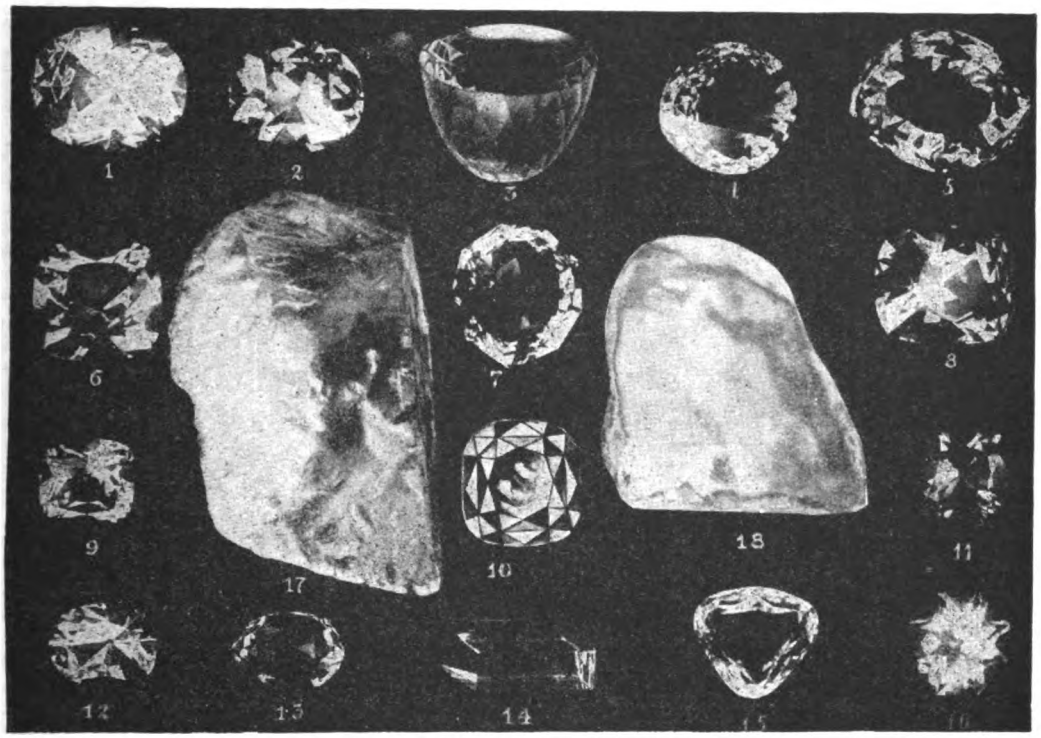
It is also found (as in Sicily) in large crystals, associated with sulphates like gypsum and celestite, which have been deposited from waters of volcanic origin.

4. Gold.

Gold. Cubic, occurring in octahedra. Malleable, ductile. H = 2½. *Sp. gr.* = 19·3. *Insoluble in acids, except aqua regia.*

The value of gold, and its use as a basis of coinage and in jewellery, depends not only on its comparative rarity, but also on its durability and resistance to the action of acids. The proportion of gold in jewellery is stated in carats, 24-carat being pure gold, and 22-carat being that usually employed.

Gold is found in sands and gravels in many parts of the world, where it occurs in nuggets, scales, and grains. It also occurs in metalliferous veins, where it is frequently associated with iron pyrites, and in the famous "banket" conglomerate, of the Rand in South Africa, and Tarkwa in West Africa.



SOME OF THE WORLD'S BIGGEST DIAMONDS.

1. *Koh-i-noor* (104⅘ *carats*); 2. *Lotetie d'Angleterre*; 3. *Great Mogul of Russia* (279⅞ *carats*); 4. *Orloff* (194¾ *carats in rose form*); 5. *Koh-i-noor after first cutting*; 6. *Regent, one of the most valuable stones from the South African mines*; 7. *Duc de Tuscane*; 8. *Etoile du Sud, which was found by a negress in the River Bogagem*; 9. *Etoile Palacre* (140 *carats*); 10. *Tiffany Yellow Diamond* (125 *carats*); 11. *Blue Diamond d'Angleterre*; 12. *Great Sancy* (53½ *carats*); 13. *Empress Eugenie* (55 *carats*); 14. *Solesik of Russia*; 15. *Nassak* (78⅘ *carats*); 16. *Pacha d'Egypt* (40 *carats*); 17. *Cullinan, before cutting* (3,024¾ *carats*); 18. *Jagersfontein* (970½ *carats*).

5. Other Native Metals.

SILVER	Cubic	H = 2½, Sp. gr. = 10·5.
COPPER	Cubic	H = 2½, Sp. gr. = 8·9.
PLATINUM	Cubic	H = 4½, Sp. gr. = 19·0.
ARSENIC	Hexagonal	H = 3½, Sp. gr. = 5·7.
ANTIMONY	Hexagonal	H = 3½, Sp. gr. = 6·6.
BISMUTH	Hexagonal	H = 2½, Sp. gr. = 9·8.
MERCURY	In liquid globules	Sp. gr. = 13·6.

IRON also occurs native, especially in meteorites, one group of which is largely composed of iron and iron-nickel alloys. Although it is rare as a superficial terrestrial mineral, owing to the ease with which it rusts, it is considered to be the chief metal of the earth's core. If the internal half of the earth is mainly iron (Sp. gr. 7·8) and the outer half rock of average Sp. gr. 3·4, the mean density of the earth is almost exactly accounted for.

II.—OXIDES

We cannot deal with all the oxides in detail. The following table affords a simple classification:—

	Name	Composition	System	H	Sp. gr.	Streak
Mono-oxides.	Cuprite	Cu_2O	Cubic	3·5	6	Brownish-red.
	Zincite	ZnO	Hexagonal	4-4·5	5·6	Orange.
	Periclase	MgO	Cubic	6	3·7	White.
	Brucite	$MgO.H_2O$	Hexagonal	2·5	2·4	White.
Sesquioxides.	Corundum	Al_2O_3	Hexagonal	9	4	White.
	Diaspore	$Al_2O_3.H_2O$	Orthorhombic	6·5	3·4	White.
	Bauxite	$Al_2O_3.2H_2O$	Amorphous	2	2·5	White.
	Gibbsite	$Al_2O_3.3H_2O$	Monoclinic	3	2·3	White.
	Hæmatite	Fe_2O_3	Hexagonal	6	5·2	Brownish-red.
	Göthite	$Fe_2O_3.H_2O$	Orthorhombic	5	4·2	Yellow-ochre.
	Limonite	$2Fe_2O_3.3H_2O$	Amorphous	5·5	3·8	Yellowish-brown.
Dioxides.	Cassiterite	SnO_2	Tetragonal	6·5	7	Grey.
	Rutile	TiO_2	Tetragonal	6·5	4·3	Yellowish-brown.
	Anatase	TiO_2	Tetragonal	5·5	3·9	White.
	Brookite	TiO_2	Orthorhombic	5·5	4	Grey.
	Quartz	SiO_2	Hexagonal	7	2·65	White.
	Chalcedony	SiO_2		7	2·6	White.
	Opal	$SiO_2.xH_2O$	Amorphous	6	2·1	White.
	Pyrolusite	MnO_2	Amorphous	2	5	Iron black.
Spinel group.	Spinel	$MgO.Al_2O_3$	Cubic	8	3·5	White.
	Magnetite	$FeO.Fe_2O_3$	Cubic	6	5·2	Black.
	Franklinite	(Fe, Zn, Mn)O. $(Fe, Mn)_2O$	Cubic	6	5·2	Brown.
	Chromite	$FeO.Cr_2O_3$	Cubic	5·5	4·5	Brown.
	Ilmenite	$FeO.TiO_2$	Hexagonal	5·5	4·8	Brown.
	Chrysoberyl	$BeO.Al_2O_3$	Orthorhombic	8·5	3·7	White.

1. Corundum.

Al_2O_3. *Hexagonal, occurring in barrel-shaped pyramids. Brittle. Fracture, conchoidal.* H = 9. *Sp. gr.* = 4. *Transparent. Streak, white. Lustre, vitreous.*

As gems, ruby and sapphire, and as a polishing material, emery, corundum is a familiar mineral. It is rarely found in good crystals, generally occurring in water-worn pebbles in river gravels. Its hardness, however, being next to that of diamond, serves to distinguish it from all other minerals. Pure corundum is colourless, but, owing to the presence of minute traces of iron, chromium, cobalt, and titanium oxides, the most beautiful exotic tints are frequently displayed. The finest crystals are used as gems, and are known by the following names: Ruby, red; Sapphire, blue; Oriental Topaz, yellow; Oriental Emerald, green; Oriental Amethyst, violet. The most valuable gems are found in Ceylon (which is famous for precious stones of all kinds) and Burma.

The dark granular varieties of corundum, often mixed with magnetite and hæmatite, are known as Emery. Corundum occurs in igneous rocks which are rich in aluminium, and it is also a characteristic mineral in certain crystalline schists and limestones. By its weathering, the hydrated minerals diaspore, gibbsite, etc., are formed.

2. Hæmatite.

Fe_2O_3. *Hexagonal, occurring in tabular crystals. Brittle.* H = 6. *Sp. gr.* = 5·2. *Colour, iron black to blood red. Streak, brownish-red. Lustre, metallic.*

Hæmatite is isomorphous with corundum, although its habit is so different. It not only occurs in crystals as beautiful steely plates, but more commonly in a massive form with a radiating structure and botryoidal surface. It is found in mineral veins and also in stratified deposits associated with sedimentary rocks. In Cumberland, for example, large masses of limestone have been completely replaced by Fe_2O_3.

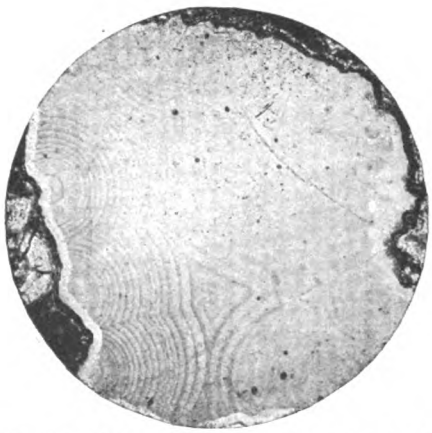
By the weathering and decomposition of hæmatite, and also of other iron minerals, *Limonite*, $2Fe_2O_3.3H_2O$, is formed, frequently indeed occurring as pseudomorphs. It may be distinguished from hæmatite by its water content and its yellowish-brown streak. Limonite is amorphous and generally forms botryoidal and earthy masses. In Sweden it forms large concretionary masses at the bottom of lakes, formed by the oxidation of ferrous solutions. Its frequent occurrence in marshes and swampy land is indicated by the name Bog-iron ore, which is applied to impure deposits of iron hydroxides formed in this way.

3. Cassiterite (Tinstone).

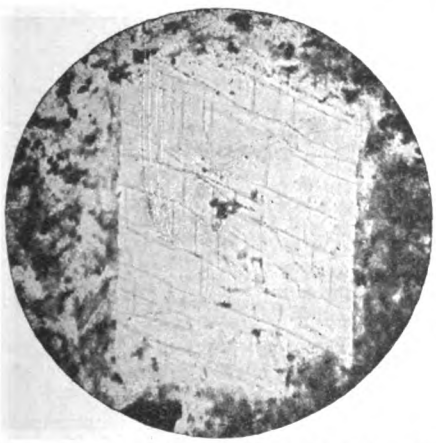
SnO_2. *Tetragonal, occurring in stout prisms, sometimes terminated with pyramids.* H = 6½. *Sp. gr.* = 7. *Colour, brown. Streak, grey. Lustre, adamantine.*

With the exception of Stannine, $Cu_2S.FeSnS$, Cassiterite is the only common mineral in which tin occurs, and it is therefore practically the only source of that useful metal. Cassiterite-bearing veins are almost always associated with pegmatites or other granitic rocks, and they include a peculiar suite of boron- and fluorine-bearing minerals such as topaz, tourmaline, and fluor spar. There

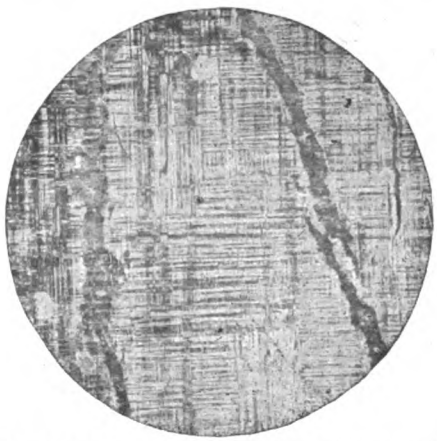
QUARTZ: Vertical section showing form; in Quartz-porphyry from Armboth Dyke, Cumberland.



CHALCEDONY: The infilling of an amygdale; in Amygdaloidal Melaphyre from Val di Fassa, Tyrol.



ORTHOCLASE: Vertical section showing form and cleavage; in Trachyte from Ischia.



MICROCLINE: Showing the characteristic "cross hatching" seen between crossed nicols; in Pegmatite from Greenland.

PLAGIOCLASE FELSPAR (Andesine): Showing form and inclusions of glass; in Andesite from Monapo River, Mozambique.

PLAGIOCLASE FELSPAR (Labradorite): Showing lamellar twinning (Albite Law) between crossed nicols; in Gabbo from Mozambique.

PHOTOMICROGRAPHS OF MINERALS,
as seen in thin sections under the microscope.

is little doubt that cassiterite has been formed from the volatile compound SnF_4.

$$SnF_4 + 2H_2O = SnO_2 + 4HF.$$

To the action of the hydrofluoric acid so produced the fluorine-bearing minerals mentioned above are due. Tinstone is found in Cornwall, Malay, Australia, and Nigeria.

4. Quartz.

SiO_2. *Hexagonal, occurring in prisms terminated with pairs of rhombohedra. Fracture, conchoidal.* H = 7. *Sp. gr.* = 2·65. *Streak, white. Lustre, vitreous to greasy.*

Quartz is the commonest of all minerals, forming at least 12 per cent. of the rocks of the earth's crust. It is an essential mineral of all granites, mica schists, and gneisses, the commonest vein-stone of veins and lodes, and the chief constituent of sands and sandstone, this fact depending on the resistance of quartz grains to weathering. As *Rock Crystal* it was held in high esteem by the ancients, who thought that it was a permanent state of ice. In this form it builds clear, transparent crystals, and a useful guide in recognising it lies in the horizontal striations which mark its prism faces. Scientifically it is of the greatest importance. In it the constancy of crystal angles was first observed. It can be cut into lenses and prisms, and may be drawn, when fused, into the finest threads, which are invaluable in delicate physical investigations. In its coloured forms the following varieties are recognised:

Amethyst, violet quartz, coloured exotically by minute traces of manganese.

Citrine, yellow quartz, cut as a gem which resembles topaz.

Cairngorm, a brown variety.

Smoky quartz, dark-coloured owing to the presence of organic matter.

Rose quartz, usually found massive; coloured by titanium.

Prase, green owing to the presence of chlorite.

The ordinary white, nearly opaque, massive form is called *Milky quartz*.

5. Chalcedony.

This is a variety of silica which is apparently amorphous, but which is really made up of minute fibrous crystals. It is always deposited from hydrous solutions, and forms crusts lining cavities, stalactitic and botryoidal masses. It has usually a banded structure, a waxy lustre, and in colour is very variable. *Jasper* is a cream, green, or red variety due to the inclusion of hydrates of iron.

Red waxy chalcedony is called *Carnelian*. *Plasma* is a leek-green chalcedony, and *Bloodstone* is plasma spotted with blood-red jasper.

The banded and variegated varieties of chalcedony are known as *Agates*. They have been deposited layer by layer in the amygdaloidal cavities of igneous rocks, and sometimes the interior is lined with crystals of quartz or amethyst. *Moss Agate* is a variety filled with dendritic or fern-like inclusions of pyrolusite and other minerals. *Onyx* is an agate with black-and-white bands, used for cameos.

Flint and Chert are compact varieties of Chalcedony which will be described in the Geology course.

6. Opal.

SiO_2xH_2O. *Amorphous. Conchoidal fracture. Streak, white. Lustre, vitreous.*

Opal is a hydrated form of gelatinous or colloidal silica, and is always deposited from solution. It is, in fact, a solidified jelly with a variable amount of water. It occurs in bands and layers, filling cavities, and forming stalactitic and botryoidal masses. It is frequently pseudomorphous, and replaces the tissue of wood, forming the well-known "wood opal," in which the organic structure is perfectly preserved. Opal is generally white, but it sometimes occurs in transparent botryoidal masses like frogs' eggs made of glass, and is then known as *Hyalite*. *Precious Opal* is the variety in which the much-prized play of colours is seen flashing from the films and cracks which penetrate the stone. The brilliant colours are born in these tiny cracks by interference, the cracks having probably formed as the jelly-like silica solidified. Opals which can be used as gems are generally found in the amygdaloidal cavities of volcanic rocks.

Geyserite is a powdery form of Opal deposited from the waters of hot-springs and geysers in New Zealand, Iceland, and the Yellowstone Park.

7. Spinel.

$MgO.Al_2O_3$ *or* $MgAl_2O_4$. *Cubic, occurring in octahedra.* H = 8. *Sp. gr.* = 3·5. *Red. Streak, white. Transparent. Lustre, vitreous.*

Spinel occurs in the gem sands of Ceylon in slightly rounded octahedra. As a gem stone it is known as Spinel or Balas Ruby when red, and as Rubicello when orange-red. A number of other minerals belong to the Spinel group, in which the mutual replacement of Mg, Fe, Zn, and Mn among the divalent, and of Fe, Mn, Cr, and Al among the trivalent metals is well exemplified. These minerals are to be regarded as aluminates, ferrates, chromates, and manganates. In addition to magnetite, chromite, and franklinite, which are considered below, the group includes:

Ceylonite, Pleonaste	.. (Mg, Fe) Al_2O_4, dark green.
Picotite	.. (MgFe) (Al, Fe, Cr)$_2O_4$, black.
Hercynite	.. $FeAl_2O_4$, black.
Gahnite	.. $ZnAl_2O_4$, green-black.

8. Magnetite.

$FeO.Fe_2O_3$ *or* $FeFe_2O_4$. *Cubic, occurring in octahedra.* H = 6. *Sp. gr.* = 5·2. *Black. Streak, black. Lustre, metallic. Magnetic.*

Magnetite is remarkable as being the most magnetic of minerals, and valuable as constituting one of the most important ores of iron. Enormous quantities are mined in Sweden, where it occurs as in association with igneous rocks. *Franklinite*, (Fe, Zn, Mn) (Fe, Mn)$_2O_4$, and *Chromite*, $FeCr_2O_4$, are similar minerals which are only slightly magnetic. Their streaks tend to be brown rather than black, and these differences distinguish them physically from magnetite.

A. H.

Continued from page 293.

LANGUAGES:

***Contributors*:—LATIN, GREEK and FRENCH (E. A. Baker, M.A., D.Lit.). GERMAN (M. A. Lewenz, M.A.[Lond.]). SPANISH, RUSSIAN and ITALIAN (Alfred Calvert, First Prizeman in Modern Languages, R.S.A., London).**

LATIN.—XXIX

At the cost of some repetition let us now review the various inflexions and uses of the verb. With the distinction between transitive and intransitive verbs you are already familiar. You also know the separate uses of the two voices, the active and the passive. All active transitive verbs may become passive by inflexion. In English, the passive is formed by the use of an auxiliary verb. Even in Latin there is some trace that auxiliary verbs were invading the province of inflexions. Thus **āmātŭs sum** and **āmātŭs ĕram** correspond precisely in form to *I am loved* and *I was loved*. Latin has no regular middle voice, but a few verbs may best be described as of the middle voice, since they express action performed upon the subject of the verb. Thus **prōfĭcisc**ŏ**r**, *I set out*, means *I put myself forward*; and **amplectŏr**, *I embrace*, may be explained as *I fold myself round*.

The Verb

Many deponent verbs are followed by accusatives, as if they were of the active voice. Others take the ablative.

When an active verb is changed to the passive voice, the object of the active verb becomes the subject of the passive, and the subject is changed into the ablative governed by the preposition **ăb** or **ā**, as in the following examples :—

Active. Marcus Cicero Tironem amabat.
Marcus Cicero loved Tiro.

Passive. Tiro a Marco Cicerone amabatur.
Tiro was loved by Marcus Cicero.

Active. Cives acclamatione orationem acceperunt.
The citizens received the speech with acclamation.

Passive. Oratio acclamatione a civibus accepta est.
The speech was received by the citizens with acclamation.

Some passives, especially those taking two accusatives in the active voice, are followed by an accusative, thus :—

Sententiam rogatus est. *He was asked his opinion.*

Persons

The subject of the Latin verb is often expressed in the form of the verb itself. The first and second persons, when they are the subjects of verbs, need never be expressed, except when an emphatic contrast is desired :—

Tu pulsas, ego vapulo. *You beat, I am beaten.*

In the third person, unless the subject of the verb is obviously the same as that of the verb immediately preceding, or it is otherwise perfectly clear to whom reference is made, this subject must be stated.

Examples :—

Hannibal ad urbem venit; milites adhortatus est.
Hannibal came to the city; he exhorted the soldiers.

Venit mihi obviam tuus puer; is mihi literas abs te reddidit.
Your son came to meet me; he gave me a letter from you.

Melior tutiorque est certa pax quam sperata victoria; haec est in tua, illa in deorum manu est.
Better and safer is certain peace than hoped-for victory; the former is in your own power, the latter in the hands of the gods.

Exceptional usages are those of the impersonal or quasi-impersonal verbs and the indefinite subject corresponding to the English *one*, *you*, *they*, or the French *on*. The English *it rains* is represented by the Latin **plŭĭt**, and so with other natural phenomena **grandĭnăt**, *it hails*, **vespĕrascĭt** *evening is drawing on*, or *it is becoming dusk*. These are true impersonal verbs, and with them may be classed certain verbs expressing mental feeling of a vague kind, such as **pĭgĕt**, *it disgusts*, **taedĕt**, *it wearies*, **paenĭtĕt**, *it makes sorry*.

There are some other verbs of a quasi-impersonal character that differ, however, essentially from these, inasmuch as the subject, though rendered in English by *it*, is really expressed by a subsequent infinitive or dependent clause. Such are the verbs **appārĕt**, *it is plain*, **dĕcĕt**, *it is becoming*, **iŭvăt**, *it delights*, **lĭbĕt**, *it pleases*, **lĭcĕt**,

it is permitted, **nĕcessĕ est**, *it is necessary*, **ŏportĕt**, *it is right*, etc. Examples :—

Licet nemini contra patriam ducere exercitum.

It is lawful to no one to lead an army against his native country.

Hanc scire oportet, filia tua ubi sit.

This it is proper to know, where your daughter is.

Non libet mihi deplorare vitam.

It does not please me (I do not care) to bewail my age.

Apparet servum hunc esse domini pauperis.

It appears that this was the slave of a poor man.

When the third person plural is used indefinitely no subject is expressed. Thus **ŭt aiunt** means *as they say*, the reference being to no particular persons but to people in general. This indefinite subject is represented, however, not always by the third person plural, but sometimes by the first person plural, as in **quae vŏlŭmŭs lĭbentĕr crēdĭmŭs**, *One willingly believes what one desires*, or by the second person singular subjunctive, as in **rēgem Brĭtannōrum saevum crēdās**, *One would believe the King of the Britons (to be) a savage.* In practically all these cases the subject might be rendered by the pronouns *we*, *you*, or *they*, or by *one*, *people*, etc., with little change of meaning.

The second person plural is used only when more than one person is referred to ; accordingly the English *you* is translated by the second person singular when it refers to one person only.

The Tenses

The Latin tenses may be classified in two ways, as complete or incomplete, and as primary or secondary.

Three of the tenses—the present, imperfect, and future—express action as not finished or incomplete, and three—perfect (whether used as the perfect proper or as an aorist), the pluperfect, and the future-perfect—express action as already finished or complete.

The tenses expressing complete or incomplete action from the point of view of the present or future are called primary tenses. These include the present, the perfect proper (i.e. when it is translated *I have loved*, etc.), the future, and the future-perfect.

The tenses expressing complete or incomplete actions from the point of view of the past are called secondary or historic tenses. They include the imperfect, the aorist perfect (translated *I loved*, etc.), and the pluperfect.

The six Latin tenses may accordingly be tabulated as follows :—

	Primary Tenses.	
1.	*Present.*	ămō, *I love* or *I am loving.*
2.	*Future.*	ămābō, *I shall love.*
3a.	*Perfect proper.*	ămāvī, *I have loved.*
4.	*Future-perfect.*	ămāvĕrō, *I shall have loved.*
	Secondary Tenses.	
3b.	*Aorist perfect.*	ămāvī, *I loved.*
5.	*Imperfect.*	ămābam, *I was loving* or *I loved.*
6.	*Pluperfect.*	ămāvĕram, *I had loved.*

Let us now proceed to consider the use of the tenses in more detail.

Present Tense

(1) The present is used to express the simple present (e.g., *I love*) or the continuous present (e.g., *I am loving*), thus :—

Claudius mortem fortiter expectat.

Claudius bravely awaits death (or *is bravely awaiting death*).

(2) It may express a customary or habitual action, or a general truth.

Germani Mercurium colunt.

The Germans worship Mercury.

Mors omnium finis est.

Death is the end of all things.

(3) It may express an attempted (that is, an incomplete) action, thus :—

Clamoribus magnis hostes terrent.

They try to frighten the enemy with loud shouts.

(4) In conjunction with **iam**, *already*, **iamdūdum** or **iampridem**, *for some time already*, and similar adverbs, it may express an action or state that has been going on for some time and is still continuing. This is translated by the English perfect, as if the action were complete, thus :—

Tuum reditum iam expecto.

For some time I have been awaiting your return.

(5) In picturesque narrative the present is sometimes used imaginatively of past action. This usage is known as the historic present, and it is important to note that the present tense in such a case is not a primary, but a secondary or historic tense. Example :—

Decemviri in concionem prodeunt, abdicantque se magistratu.

The decemvirs proceed to the assembly, and retire from the magistracy.

(6) After **dum**, *while*, the present tense is commonly used, whatever the tense of the main verb, so long as the action is regarded as contemporaneous with that of the main verb, as in :—

Dum arma parant, hostes fugerunt.

While they were (are) getting their arms ready, the enemy fled.

Imperfect Tense

(1) The imperfect usually corresponds to the English continuous past, describing an action that was going on at some past time :—

Ibam forte Via Sacra.
I was going by chance along the Sacred Way.

(2) It may often, however, be rendered by the simple past, as in :—

Tendebantque manus ripae ulterioris amore.
And they stretched out their hands in longing for the further shore.

(3) It is used to express habitual action or frequent occurrence, thus :—

Dicebat melius quam scripsit Hortensius.
Hortensius used to speak better than he has written.

(4) Like the present, the imperfect may be used to express an attempted action :—

Æneas lenibat dictis animum.
Æneas tried to soothe her mind with words.

(5) Again, like the present, the imperfect is used with **iamdūdum** and similar adverbs to express an action going on for some time, and is translated by the English pluperfect :—

Iamdudum Romam visere cupiebam.
I had long been desiring to visit Rome.

(6) In letters the imperfect is used when in English we should use the present.

Pridie Idus haec scribebam ante lucem.
I write (was writing) this before dawn on the eve of the Ides.

Exercise 28

Translate into English :—

1. Quis hic est homo, quem ante aedes video hoc noctis ? 2. In his undis et tempestatibus ad summam senectutem maluit iactari, quam in illa tranquillitate atque otio iucundissime vivere. 3. Male se res habet quum, quod virtute effici debet, id tentatur pecunia. 4. Tanquam ita fieri non solum oporteret, sed etiam necesse est. 5. His cognosci licuit quantum esset hominibus praesidii in animi firmitudine. 6. Eum rogato ut huc veniat. Licet.

Translate into Latin :—

1. I desire indeed and I have long desired to visit Alexandria. 2. The rustic waits for the river to flow away. 3. Here it was possible to realise how much fortune can do in war. 4. The deeds of the former, the sayings of the latter, are extolled. 5. (A people) who in their own tongue are called Celts inhabit the third portion. 6. It was decided by (pleased) the senate that the proconsul C. Cassius should obtain Syria.

Key to Exercise 26

1. Philodemus is bedrenched with hot water. 2. Sweat bursting forth from the whole body drenched the bones and limbs. 3. We are performing a service of necessity and a serious task. 4. I will go the way that I have begun. 5. Vitellius prematurely wasted the fortune of the principals in idle luxury and prodigal banquets. 6. I write (have written) this to you now, as you desire.

1. Ille Idibus a mè profectus est. 2. Rhenus oritur ex Lepontiis. 3. Ab aliquo sermo oritur. 4. Nascetur pulchra Troianus origine Caesar. 5. Exercitatione sudor monetur. 6. Praecepit eis ne se ex eo loco moverent.

E. A. B.

FRENCH.—XXIX

Adverbs are divided into eight classes :—

(1) Of place, as **ici**, *here*, **où**, *where*, **là**, *there*, **ailleurs**, *elsewhere*.

(2) Of time, as **aujourd'hui**, *to-day*, **hier**, *yesterday*, **d'abord**, *at first*.

(3) Of manner, as **doucement**, *softly*, **sagement**, *wisely*, **prudemment**, *prudently*.

(4) Of quantity, as **peu**, *little*, **trop**, *too much*, **beaucoup**, *much, many*.

(5) Of affirmation, as **oui**, *yes*, **certes**, *certainly*, **vraiment**, *really*.

(6) Of negation, as **non**, *no*, **nullement**, *by no means*, **ne**, **pas**, *not*.

(7) Of interrogation, as **comment ?** *how ?* **combien ?** *how much ?* **où ?** *where ?*

(8) Of doubt, as **peut-être**, *perhaps*, **probablement**, *probably*.

Adverbs of manner are formed from adjectives by the addition of **-ment** to the feminine form of the latter, the second vowel being dropped if the adjective ends with two, thus : **utile**, *useful*, **utilement**, *usefully ;* **polie**, *polite*, **poliment**, *politely ;* **aisée**, *easy*, **aisément**, *easily ;* **heureuse**, *happy*, **heureusement**, *happily ;* **belle**, *beautiful*, **bellement**, *beautifully*, **folle**, *foolish ;* **follement**, *foolishly*.

Most adjectives ending in **-nt**, **-nte**, form their adverbs in **-mment**, thus : **prudent**, *prudent*, **prudemment**, *prudently ;* **élégant**, *elegant*, **élégamment**, *elegantly*.

The following are exceptions : **lent**, *slow*, **lentement**, *slowly ;* **présent**, *present*, **présentement**, *presently ;* **véhément**, *vehement*, **véhémentement**, *vehemently*.

Traîtreusement, *treacherously*, is formed from an old feminine **traîtreuse**, of **traître**, *treacherous*, and **brièvement**, *briefly*, from the old feminine form **briève** of **bref**.

Gentiment, *prettily*, is formed by the dropping of the silent **-l** in **gentil**, *pretty*.

In the following adverbs an acute accent is put over the **e** preceding **-ment**, which **e** is mute in the adjective :—**aveuglément**, *blindly ;* **commodément**, *conveniently ;* **communément**, *commonly ;* **conformément**, *conformably ;* **confusément**, *confusedly ;* **diffusément**, *diffusely ;* **énormément**, *enormously ;* **expressément**, *expressly ;* **importunément**, *importunately ;* **immensément**, *immensely ;* **impunément**, *with impunity ;* **incommodément**, *inconveniently ;* **obscurément**, *obscurely ;* **opiniâtrément**, *obstinately ;* **precisément**, *precisely ;* **profondément**, *profoundly ;* **uniformément**, *uniformly*.

A few adjectives are sometimes used

adverbially, and are then, of course, invariable, thus—

Chanter juste, *to sing in tune.*	Coûter cher, *to cost dear.*
	Parler haut, *to speak loud.*

Adverbial phrases consist of several words united together and having the force of an adverb, as **tout à coup**, *suddenly;* **peu à peu**, *by degrees;* **tout à l'heure**, *immediately;* **de temps en temps**, *now and then.*

Adverbs of quantity usually take the preposition **de** before the noun they qualify, thus—

Elle a beaucoup d'esprit,	*She has plenty of wit.*
J'ai peu d'amis,	*I have few friends.*

Adverbs modifying a verb in a simple tense are usually placed after the verb, as in—

Que de gens prennent hardiment le masque de la vertu !	*How many people boldly assume the mask of virtue !*

In compound tenses they are placed between the auxiliary and the participle, as in—

Vous avez mal fait,	*You have done wrongly.*

Adverbs that are very long are sometimes put after the participle. Thus we may have **cela est heureusement exprimé** or **cela est exprimé heureusement**, *that is happily expressed.*

When an adverb modifies the whole sentence it is placed at the beginning, thus—

Heureusement, il est venu à temps,	*Fortunately, he came in time.*

Adverbial phrases are always put after the verb, as in the last example, and in—

Donnez-le-moi tout de suite,	*Give it to me at once.*
La maison s'est écroulée tout d'un coup,	*The house tumbled down suddenly.*

The adverbs **ainsi**, *so*, **bien**, *well*, **jamais**, *never*, **mal**, *badly*, **trop**, *too much*, are always placed between the preposition and the infinitive, thus—

Pour le bien faire,	*To do it well.*
Pour n'avoir jamais menti,	*For never having told a lie.*

Adverbs of time take precedence of adverbs of place, and both take precedence of those of manner, as in—

Elle est allée ce matin en France,	*She went to France this morning.*
Elle est allée à Boulogne par bateau à vapeur,	*She is gone to Boulogne by steamer.*

Aujourd'hui, *to-day*, **demain**, *to-morrow*, **hier**, *yesterday*, may be put before or after the verb, but never between the auxiliary and the participle, thus—

Nous sommes arrivés aujourd'hui,	*We arrived to-day.*
Aujourd'hui il fait beau temps ; demain il pleuvra,	*To-day it is fine; to-morrow it will rain.*

The negative **ne** is used idiomatically without any negative sense after the conjunctions **à moins que**, *unless*, **de peur que**, **de crainte**, and also after **autre**, *different*, and the verbs **craindre**, **empêcher**, etc., **que**, *lest*, as in—

A moins que vous ne lui parliez,	*Unless you speak to him.*
Il est tout autre qu'il n'était,	*He is very different from what he was.*
Vous avez bien peur que je ne change d'avis,	*You are much afraid that I may change my mind.*

Prepositions governing verbs take the infinitive, with the exception of **en**, which takes the present participle, thus—

Il l'a dit pour cacher sa faute,	*He said it to hide his fault.*
Il lit en marchant,	*He reads as he walks.*

The prepositions **à**, **de**, **en**, **sans**, must be repeated before every complement, thus—

Telle est la multitude, et sans frein et sans lois,	*Such is the multitude, without restraint and without laws.*
Une loterie de biens, de rangs, de dignités, de droits,	*A lottery of possessions, of ranks, of dignities, of rights.*

Conjunctions are used to connect words or propositions. They may be simple, as **et**, *and*, **ou**, *or*, **comme**, *as*, **que**, *that*, or composed of several words, when they are called conjunctive locutions, as **afin que**, *in order that*, **à moins que**, *unless*, **parce que**, *because.*

Conjunctions connecting propositions are followed by verbs in the indicative, conditional, or subjunctive mood. They cannot take the infinitive, which is a verbal substantive. Examples :—

Il est sûr que je l'ai dit, car il m'a entendu,	*He is sure that I said it for he heard me.*
Il fut décidé qu'il partirait,	*It was decided that he should start.*
Quoique vous le sachiez,	*Although you know it.*

The following conjunctions always require the subjunctive after them. Those marked with an asterisk require **ne** before the verb.

afin que, *in order that.*	non que, *not that.*
*à moins que, *unless.*	non pas que, *not that.*
au cas que, *if.*	posé que, *supposing that.*
avant que, *before that.*	pour que, *that, in order that.*
bien que, *although.*	
*de crainte que, *for fear.*	pourvu que, *provided that.*
de peur que, *lest.*	
en cas que, *in case.*	quoique, *although, though.*
encore que, *although.*	sans que, *without that.*
loin que, *far from, not that.*	soit que, *whether.*
non obstant que, *notwithstanding.*	supposé que, *suppose that.*

VOCABULARY

abuser, *to deceive.* obstiné, *obstinate.*
agir, *to act, behave.* propre, *own.*
se blesser, *to be wounded.* protéger, *to protect.*
le conseil, *advice.* régler, *to regulate.*
instruire, *to instruct.* réprimer *to repress.*
le libraire, *the bookseller.* le songe, *the dream.*
la mollesse, *effeminacy.* soutenir, *to support.*
le naufrage, *the shipwreck.* la volupté, *voluptuousness.*

Exercise 55

1. Il est moins paresseux et moins obstiné que son frère. 2. Il n'y aurait pas tant de peine et de misère dans ce monde. 3. Ce libraire a beaucoup de bons et de mauvais ouvrages dans son magasin. 4. Le ciel sur nos souhaits ne règle pas les choses. 5. L'estime est le vrai principe de la considération, qui n'est pas toujours attaché aux dignités. 6. Les rois ne sont point protégés par les lois. 7. Je ne puis souffrir qu'un de leur vaisseaux fasse naufrage. 8. Dans son appartement elle n'osait rentrer. 9. Qui vit haï de tous ne saurait vivre longtemps. 10. La liberté ne cesse d'être aimable. 11. Nul n'est heureux s'il ne jouit de sa propre estime. 12. Il est plus modeste qu'il ne le paraît. 13. Je crains qu'un songe ne m'abuse. 14. La pluie empêcha qu'on ne se promenât dans les jardins. 15. Il ne parle pas autrement qu'il agit. 16. Il n'est pas plus modeste qu'il le paraît. 17. L'éloquence est un art très sérieux, destiné à instruire, à réprimer les passions, à corriger les mœurs, à soutenir les lois. 18. Je vous donne ceci pour vous et pour votre frère. 19. Il perd sa jeunesse dans la mollesse et dans la volupté. 20. Il vint ici de peur d'être vu.

Exercise 56

1. Where is your brother? He is here. 2. He received us well. 3. Your brother hurt himself yesterday. 4. He has never said that. 5. I do not sing much. 6. Ambition has scarcely any limits. 7. No one likes to receive advice. 8. A wicked man never knows how to forgive. 9. I cannot go there. 10. I may not go there. 11. He dare not say so. 12. He is impudent enough not to say so. 13. Lest you might be deceived. 14. He is very different from what he was. 15. He speaks and acts very differently. 16. He does not speak otherwise than he acts. 17. I fear he may not come. 18. I am afraid that my brother may not come. 19. He sat down after having spoken. 20. I am pleased to see you.

Key to Exercise 48

1. Je le lus avant-hier. 2. A quelle heure le négociant est-il venu ce matin? 3. Y a-t-il plus d'un an que vous apprenez l'allemand? 4. Il y a plus de quatre ans que je l'apprends. 5. Le médecin lui recommande de changer d'air. 6. Je ferai bâtir une maison l'année prochaine. 7. Avez-vous fait bouillir ce gigot de mouton? 8. Ferez-vous attention à votre travail? 9. Je voudrais que le roi jugeât par là combien il est loin de connaître la verité. 10. Le roi se mit à rire. 11. J'ai lu ce petit livre. 12. Il faut que je vous conte une petite historiette. 13. Monsieur, je vous prie, lisez ce petit livre. 14. Obéissez à votre précepteur. 15. Je lui obéis toujours. 16. Pourtant elle s'ennuyait beaucoup. 17. On lui plaisait surtout en la trouvant incomparable. 18. Certes, elle fut surprise en lisant cela. 19. A présent personne ne le connaissait plus. 20. Il éteignit les chandelles.

Key to Exercise 49

1. I have ordered her and him to do it. 2. He will know well how to prevent you and his other enemies from injuring him. 3. They know only me here. 4. My cousin has written to thee and thy sister. 5. The minister has promised to us and to them that she will be pardoned. 6. Your father will entrust you to me during the voyage. 7. My brother sent me to you yesterday. 8. I will not send thee to him. 9. He will not entrust me to them. 10. He does not trust thee. 11. One must think of oneself. 12. That concerns you. 13. I declare to you, to yourself, that that is untrue. 14. Take care of yourself. 15. He will write to them only. 16. I have seen him and his father. 17. I go to your house to speak to your brother and to see you. 18. I want money to buy goods. 19. Will you give it to us? 20. I am willing to lend it to you.

Key to Exercise 50

1. Pouvez-vous me les donner? 2. Je ne puis vous les donner. 3. Votre frère peut-il le lui envoyer? 4. Il ne veut pas le lui envoyer. 5. Qui veut le leur prêter? 6. Personne ne veut le leur prêter. 7. Envoyez-les-nous. 8. Ne nous les envoyez pas. 9. Donnez-nous-en. 10. Ne leur en envoyez pas. 11. Envoyez-le-leur, pour les contenter. 12. Je vous en enverrai là. 13. Je puis vous l'y envoyer. 14. Je les ai vus, et lui et son père. 15. Il les a reconnues, sa mère et elle. 16. Ils les ont appuyés, toi et ton cousin de tout leur crédit. 17. Je ne connais que lui ici. 18. Il ne veut voir qu'elle. 19. Ils nous envoient à vous pour terminer cette affaire. 20. Mon tuteur m'a confié à elle parce qu'il ne connaît qu'elle dans cette ville.

E. A. B.

ITALIAN.—II

The Definite Article has different forms corresponding to gender and number.

	Sing.	*Plur.*
(*a*) Before masculine nouns beginning with a consonant	= il	i
(*b*) Before masculine nouns (and adjectives) beginning with **s** (followed by another consonant) or **z**	= lo	gli
(*c*) Before masculine nouns beginning with a vowel	= l' (= lo)	gli
(*d*) Before feminine nouns beginning with a consonant	= la	le
(*e*) Before feminine nouns beginning in the singular with a vowel, and, optionally, before feminine nouns beginning in the plural with **e**	= l' (= la)	l' (= le)

Examples

	Sing.	*Plur.*
(*a*)	il negoziante, *the merchant.*	i negozianti, *the merchants.*
(*b*)	lo studente, *the student.*	gli studenti, *the students.*

(*b*) lo zúcchero, *the sugar.*	gli zúccheri, *the sugars.*
(*c*) l'amico, *the friend.*	gli amici, *the friends.*
(*c*) l'invío, *the sending* (shipment of goods).	gl'invíi (gli invíi), *the sendings.*
(*d*) la cassa, *the case, box* (wooden, etc.).	le casse, *the cases.*
(*e*) l'ora, *the hour.*	le ore, *the hours.*
(*e*) l'invitazione, *the invitation.*	le invitazioni, *the invitations.*
(*e*) l'etichetta, *the ticket* (label).	l'etichette or le etichette, *the tickets* (labels).
Gl'inglesi sono venuti oggi (pron. ód-jee),	*The English have* (are) *come to-day.*

Note—**gg** before **e** or **i** is always like **d-j**, whilst **cc** before the same vowels is pronounced **t-ch**, as **ecce**llente, et-chel-len-tay. **Gl'** is often found instead of **gli** before **i**.

L'inglese ha venduto lo zúcchero,	*The Englishman has sold the sugar.*

Here **L'** = lo.

L'or**a** è venut**a**,	*The hour has* (is) *come.*

Here **L'** = la before the vowel **o**.

Le ore sono venute,	*The hours have* (are) *come.*
Avete pagato il conto? Sì, signore, l'ho pagato,	*Have you paid the account? Yes, sir, I have paid it.*
L'anno è quasi finito,	*The year is nearly finished* (over).
Gli anni sono quasi finiti,	*The years are nearly finished.*
Il lavoro è fatto (irregular past part. of **fare**),	*The work is done.*
I lavori sono fatti,	*The labours are done.*
L'economía è fatta,	*The economy* (saving) *is made.*

L' = la.

L'economíe (or preferably, le economíe) sono fatte,	*The economies* (savings) *are made.*

L' = le before **e**, as in economíe; feminine nouns beginning with **e** sometimes are preceded in the plural by **l'** instead of **le**.

L'etichetta è bella,	*The ticket* (label) *is nice* (beautiful).
L'etichette (or better, le etichette) sono belle,	*The tickets are nice* (beautiful).
Il nostro compratore è buono,	*Our buyer is good.*

Literally: *The* our buyer is good. The definite article generally precedes a possessive adjective, my, his, our, etc., when not referring to a near relative in the singular.

I nostri compratori sono buoni,	*Our buyers are good.*
Lo studente vuol partire,	*The student wants to leave.*
Gli studenti vógliono partire,	*The students wish to depart.*
L'amico (pron. am-eé-ko) è uscito (= oo-sheé-to),	*The friend has* (is) *gone out.*
Gli amici (pron. am-eé-chee) sono usciti,	*The friends have* (are) *gone out.*
La nostra amica è uscita,	*Our* (female) *friend has gone out.*
Le nostre amiche (pron. am-eékay) sono uscite,	*Our* (lady) *friends have* (are) *gone out.*
L'invío è arrivato,	*The sending* (shipment of goods, etc.) *has* (is) *arrived.*
Gl'invíi (or gli invíi) sono arrivati,	*The shipments have arrived.*

The ending **-io** makes plural **-ii**. Note that the **i** bears the emphasis or stress.

Il loro calam**áio** è d'oro (= di oro),	*Their inkstand is of gold.*
I loro calam**ái** sono qui,	*Their inkstands are here.*

In the ending **-io**, not bearing the stress, the **o** disappears in the plural and only **i** remains.

La vostra citt**à** è stata onorat**a**,	*Your town* (city) *has been honoured.*
Le sue citt**a** sono state onorat**e**,	*His towns have been honoured.*

Any noun with the grave accent on the last letter, a vowel, remains unaltered in the plural.

L'agente è stat**o** onorat**o** (favorito) di un órdine,	*The agent has been honoured* (favoured) *by* (di = of) *an order.*
Gli agenti sono stat**i** onorat**i** (favorit**i**) di due órdini,	*The agents have been honoured* (favoured) *by two orders.*
Siete arrivato a tempo? No, sono arrivato tardi,	*Did you arrive in time? No, I arrived late.*
Siete venuto tardi,	*You* (one person, masc.) *have* (are) *come late.*
Siete venuta tardi,	*You* (one person, fem.) *have* (are) *come late.*
Siete venuti tardi,	*You* (more than one person, masc., or both masc. and fem.) *have* (are) *come late.*
Siete venute tardi,	*You* (more than one person, fem.) *have* (are) *come late.*

It will be seen that both gender and number must always be shown wherever possible. "Tardi," being an adverb, is invariable.

The Indefinite Article.—A, an or **one** has the following forms:

Un before a masculine noun.
Una before a feminine noun.
Uno, not **un**, before **z** or *impure* **s**.
Un', not **una**, before a vowel.

Examples

Un' ora ed (often used for "**e**" before a vowel) un minuto,	*An hour and a minute.*
Uno studente che ha una léttera,	*A student who has a letter.*
D'un' ora,	*Of an hour.*
Ad un' ora,	*To* (at) *an hour.*

Before a vowel **di** often becomes **d'** and **a** becomes **ad.**

VOCABULARY

il libro, *the book.*
da, *from, by, at the house of* (= French *chez*).
Parigi, *Paris.*
confermare, *to confirm, acknowledge.*
il ricevimento, *the receipt.*
pregándovi (pregare), *requesting you* (ci added to verb = *us* or *to us*, vi added to verb = *you* or *to you*, mi added to verb = *me* or *to me*).
vi, *you, to you.*
vi salutiamo distintamente, *we salute you distinctly, distinguishedly* (= we are, dear Sirs, yours truly—a usual ending of a business letter).
vi saluto con tutta stima, *I salute you with all esteem, respect* (= I am, dear Sirs, yours faithfully—a usual ending of a business letter).
distintamente, *distinctly, clearly, distinguishedly.*
l'attesa (f.), *the expectation.*
solléciti vostri órdini, *your kind orders.*
con, *with.*
la stima, *the esteem, respect.*
del 19 (diciannove) corrente, *of the 19th instant.*
insieme a, *together with* (lit., *to*).
ai (= a i), *to the.*
il campione, *the pattern.*
il velluto, *the velveteen.*
la fódera, *the lining.*
lo spinato, *the drill* (cloth).
altro, *other.*
l'artícolo, *the article.*
scritto (scrívere), *written.*
gli agenti-spedizionieri, *the forwarding agents.*
se, *if.*
possíbile, *possible.*
mandare, inviare, *to send.*
mandate (m a n d a r e), *send!*
sempre, *always.*
la fattura, *the invoice.*
colla (= con la), *with the.*
il signore, *the gentleman.*
accusare, *to acknowledge.*
mi, *me, to me.*
della (= di la), *of the.*
la spedizione, *the sending, shipment.*
alla (= a la), *at the, to the.*
la scadenza, *the due date, maturity.*
veduto, visto (vedere), *seen.*
fabbricare, *to manufacture, make.*
la tela, *the cloth.*
in, *in, into, to.*
Italia, *Italy.*
ringraziare per (or di), *to thank for.*
eseguire, *to execute.*
a, *to, at.*
basso, *low.*
prima di, *before.*
fare vísita, *to visit.*
lo stampatore, *the printer.*
del (= di il), *of the.*
il magazzino, *the warehouse, shop.*
l'impiegato, *the employee.*
lavorare, *to work.*
il teatro, *the theatre.*
per, onde (both with infinitive), *in order to.*
divertire, *to divert, enjoy.*
gli, *to him.*
detto (dire), *said, told.*
nascosto, *hidden* (irreg. past participle of nasc̀ondere, *to hide, conceal*).
niente, nulla, *not anything, nothing.*
diversi, *different, various, several.*
ci, *to* (for) *us.*
riprodurre, *to reproduce.*
esattamente, *exactly.*
il disegno, *the design.*
Milano, *Milan.*
Venezia, *Venice.*
Livorno, *Leghorn.*
il denaro, il danaro, *the money.*
senza fallo, *without fail.*
passare, *to pass.*
rapidamente, *rapidly.*
il dopopranzo, il pomeriggio, *the afternoon.*
la verità, *the truth.*
la paúra, il timore, *the fear.*
noi, *we.*
cioè (= ciò è), *that is.*
ristretto (adj. and past participle of restríngere), *restricted.*
il prezzo ristretto, *the low price.*
primario, *first-class.*
l'invitazione (f.), l'invito (m.), *the invitation.*
parlare, *to speak.*
parliamo (parlare), *we speak.*
la pezza, *the piece* (of cloth, etc.).
la tela bianca, *white* (unbleached) *cloth, white goods.*
la tratta, *the draft.*
presentare, *to present.*
la quale, *which.*
dare or fare buona accoglienza a, *to honour* (lit., to give or make good reception to).
il diritto, *the right.*
immagazzinare, *to warehouse, store.*
loro (invariable), *them, to them.*
finora, *till now.*
il mercato, *the market.*
la casa di esportazione, *the shipping firm.*
importante, *important.*
credo (crédere), *I believe.*
l'argento (m.), *the silver.*
arrívano (arrivare), *they arrive.*
lo, *it, so.*
ordinare, *to order.*
uscire, *to go out.*
scrivete (scrívere), *write!* (imper.).
ciascuno, ognuno, *each.*

Exercise 3

Translate into English :—

1. Gli studenti che hanno comprato i libri sono già partiti da Londra per Parigi. 2. Pregándovi di confermarci ricevimento, vi salutiamo distintamente. 3. In attesa di solléciti vostri órdini vi saluto con tutta stima. 4. Ho ricevuto la vostra (= léttera) del 19 (diciannove) corrente insieme ai nuovi campioni di velluti, fódere, spinati ed altri artícoli. 5. Le léttere sono partite insieme ai campioni. 6. Gli agenti-spedizionieri avéndoci scritto, è certo che le merci sono già arrivate. 7. Se vi è possíbile, mandáteci (imperative) sempre la fattura colla merce. 8. Questi signori mi hanno accusato ricevimento della spedizione e mi hanno pagato il conto alla scadenza. 9. Abbiamo dato buona accoglienza alla tratta che ci è stata presentata ieri. 10. Avendo fatto buona accoglienza a tutte le nostre tratte, i clienti hanno il diritto di aspettare la consegna, cioè di ricévere le merci, senza indugio. 11. Hanno immagazzinato tutti i colli che abbiamo mandati (masc. pl., because a past participle with auxiliary verb *avere* generally agrees with preceding direct object, che = colli, masc. pl.) loro finora. 12. Ho veduto (or visto) gl'inglesi che hanno fabbricato la tela da noi spedita (inviata, mandata) in Italia. 13. Mi ha ringraziato per (di) aver (= avere) eseguito l'órdine a un prezzo così basso (ristretto). 14. Prima di partire, abbiamo fatto vísita a tutti i clienti della città. 15. Quando è che sono usciti gli amici dello (= di lo) stampatore delle pezze immagazzinate qui? 16. Le ore del lavoro in questo magazzino sono troppó lunghe; gl'impiegati sono sempre stanchi. 17. Ho lavorato molto e sono stato al (= a il) teatro per divertirmi un poco. 18. Gli ho detto tutto francamente e non gli ho nascosto niente (or nulla). 19. Ci sono venute diverse invitazioni (diversi inviti) che abbiamo accettate (accettati, if invitl) con molto piacere. 20. Gli stampatori dícono che non hanno potuto riprodurre esattamente i disegni ordinati loro.

Exercise 4

Translate into Italian :—

1. Our travellers have left this morning for Paris, Milan, Venice and Leghorn. 2. Having bought a cargo of three thousand bags of coffee, I have no more money. 3. They are expecting the sendings (shipments of goods) this week without fail. 4. The students have accepted the invitations with much pleasure. 5. The sugar has (is) not yet arrived. 6. The years have (are) passed very rapidly. 7. We are speaking (translate, we speak) of a sugar (of a quality of sugar) which you have bought last year (the year past). 8. It is a ticket that we have seen often on the (sulle = su le) pieces of white goods that are sold in this market. 9. He has told me that the student wishes to leave to-day. 10. They

have paid a visit to (ad) an important (first-class) shipping firm. 11. I believe that the students wish to buy these silver inkstands (inkstands of silver). 12. The shipments which have (are) arrived by the same steamer have (are) not been sold at (ad) a reasonable price (translate, price reasonable). 13. The invitations have (are) come too late; we cannot accept invitations which do not arrive in time. 14. They have spoken about (of) the (degli) friends who have done the work. 15. Have they paid the account? Yes, sir, they have paid it this afternoon. 16. Our friends say that they are tired of so much work. 17. You have spoken frankly, you have hidden nothing and you have told the truth without fear. 18. We have been able to reproduce exactly the design which you have ordered of them (translate, ordered to them). 19. The friends of the printer of the pieces stored here have gone out. 20. Before going out, write a letter to each of these customers. A. C.

SPANISH.—II

Gender of Nouns.—Nouns are Feminine with the following terminations: **a, d, ion, z.** Those with other endings are Masculine, as:

¿ Ha llegàdo **el tren** ?	*Has the train arrived ?*
¿ Han hècho Vs. **la lección** ?	*Have you* (pl.) *done the lesson ?*
La càrta está escrìta,	*The letter is written.*
Tènga V. **la bondàd** de entràr !	*Have the goodness to come in* (please come in) !
La luz eléctrica es mùy útil,	*(The) electric light is very useful.*

The Possessive Case does not exist in Spanish. The Genitive Case is used instead, as:

El pedìdo del cliènte no ha llegàdo,	*The customer's order* (the order of the customer) *has not arrived.*
El cajèro del negociànte àun no ha pagàdo las cuèntas,	*The merchant's cashier has not yet paid the accounts.*
El compradòr del cliènte del sòcio ha vìsto las muèstras,	*The partner's customer's buyer* (the buyer of the customer of the partner) *has seen the patterns.*

N.B.—**No** always precedes the verb.

The Verb.—the following exceptions to the rules for the endings in the Present and Past Participles, as set forth in the first lesson, should be noted.

Present Participle

dicièndo, *saying, telling,* from decìr, *to say, tell.*
durmièndo, *sleeping,* from dormìr, *to sleep.*
irguièndo, *raising,* from erguìr, *to raise.*
murièndo, *dying,* from morìr, *to die.*
pidièndo, *asking,* from pedìr, *to ask, to order, ordering* (goods, etc.).
pudièndo, *being able,* from podèr, *to be able.*
sintièndo, *feeling, being sorry, regretting,* from sentìr, *to feel, to be sorry for, to regret.*
vinièndo, *coming,* from venìr, *to come.*

Past Participle

abièrto, *opened,* from abrìr, *to open.*
cubièrto, *covered,* from cubrìr, *to cover.*
dìcho, *said, told,* from decìr, *to say, tell.*
escrìto, *written,* from escribìr, *to write.*
frìto, *fried,* from freìr, *to fry.*
hècho, *made, done,* from hacèr, *to make, do.*
impréso, *printed,* from imprimìr, *to print.*
muèrto, *dead,* from morìr, *to die.*
puèsto, *put,* from ponèr, *to put.*
prèso, *seized, imprisoned, caught,* from prendèr, *to seize, imprison, catch.*
prescrìto, *prescribed,* from prescribìr, *to prescribe.*
provìsto, *provided,* from proveèr, *to provide.*
ròto, *broken,* from rompèr, *to break.*
vìsto, *seen,* from ver, *to see.*
vuèlto, *returned,* from volvèr, *to return* (so all other verbs ending in -olver).

Past Imperfect Indicative of **Haber,** *to have,* an irregular auxiliary verb, used only as such before a past participle, in order to form a compound tense:

Sing.	*Plur.*
1. yo había, *I had.*	nosòtros (nosòtras), habíamos, *we had.*
2. tu habías, *thou hadst.*	vosòtros (vosòtras), habíais, *you had* (familiar).
3. él (èlla) había, *he* (*she*) *had.*	èllos (èllas) habían, *they had.*
V. había, *you had.*	Vs. habían, *you had.*

The student will remember to use only **v.** or **vs.** for *you,* referring to one or more persons respectively, with the third person singular or plural of the verb.

Examples

V. había abièrto los sobres,	*You had opened the envelopes.*
¿ Han cubièrto Vs. las mercaderías ?	*Have you covered the goods ?*
Dicièndo èsto, el ha ròto el sèllo de la càrta,	*Saying this he broke* (*has broken*) *the seal of the letter.*
El ladrón está prèso,	*The thief is caught.*
Habíamos dìcho la verdàd á nuèstro representànte,	*We had told the truth to our agent* (*representative*).
Murièndo pobre, ha dejàdo mùy pòce dinère,	*Dying* (*as he died*) *poor, he has left very little money.*
¿ Qué habían vìsto Vs. en el almacén ?	*What had you seen in the warehouse ?*
El jèfe de la càsa había muèrto,	*The head of the house had died.*
Yo había vuèlto las lètras á Vs.	*I had returned the bills* (of Exchange) *to you.*

Future of **Habèr,** *to have* (auxiliary verb).

Sing.	*Plur.*
1. habré, *I shall have.*	habrèmos, *we shall have.*
2. habrás, *thou wilt have.*	habréis, *you will have* (familiar).
3. habrá, *he will have.*	habrán, *they will have.*
V. habrá, *you will have,*	Vs. habrán, *you will have.*

Hablàr (Infinitive), *to speak* (regular verb).

Future Tense

Sing.	*Plur.*
1. hablaré, *I shall speak,* etc.	hablarèmos, *we shall speak,* etc.
2. hablarás, *thou wilt speak,* etc.	hablaréis, *you will speak,* etc.
3. hablará, *he will speak,* etc.	hablarán, *they will speak,* etc.

The usual mode of forming the future of any regular verb is to add to the infinitive the following terminations: **-é, -ás, -á, -èmes, -éis, -án.**

These endings are abbreviations of the present tense of **habèr,** so that **hablaré** literally means **hablar he,** *to speak I have,* i.e., *I have to speak.*

The above terminations for the future indicative are added also to the Infinitive (the latter being often modified or altered) of any irregular verb, as: **ponèr,** *to put;* future: **pondré, pondrás,** etc., *I shall put;* **habèr, habré,** etc. (as above), *I shall have,* etc.

Examples

El estampadòr habrá imprèso las circulàres mañàna sin fàlta,	*The printer will have printed the circulars to-morrow without fail.*
Hablarèmos con V. sòbre este asùnto,	*We shall speak with you on this subject.*
Pudièndo pagàr, pedirèmos los nuèvos dibùjos,	*Being able* (if *or* as we are able) *to pay, we shall order the new designs.*
Pidièndo los géneros hoy, los recibirán Vs. mañàna,	*Ordering* (by ordering) *the goods to-day, you will receive them* (los) *to-morrow.*
Durmièndo hàsta las nuève, llegarèmos tàrde al despàcho,	*Sleeping* (if we sleep) *until* 9 *o'clock* (the nine, **horas,** *hours,* being understood), *we shall arrive late at the office.*
¿ Qué dirá (fut. of **decir**) él, si no pàgo la cuènta ?	*What will he say if I do not pay the account ?*
¿ Habrán escrìto èllos a los clièntes ?	*Will they have written to the customers ?*
¿ Dónde había puèsto yo la nòta de pedìdo ?	*Where had I put the order-note ?*
Ya habíamos comìdo los huèvos que estàban fritos,	*We had already eaten the eggs which were fried* (literally, already we had, etc.).

VOCABULARY

ofendèr, *to offend.*
en, *in* (sometimes), *on.*
sòbre, *on, over, above.*
mandàr, *to order, command, send.*
las mercancías, *the goods.*
mùcho, *much.*
seguìr, *to follow.*
seguìdo (past part.), *followed.*
la instrucción, *the instruction.*
la nòta, *the note.*
la màno, *the hand.*
tòdo, *all,* tòda (f.), tòdos (m. pl.), tòdas (f. pl.).
pàra, *for, in order to.*
cogèr, *to catch.*
la pérdida, *the loss.*
su (sus), pl., *his* (*her, your, their*).
bàjo, *low.*
si, *if, whether* (note sí, *yes*).
valèr, *to be worth.*
valía (past imperf.), *it,* etc., *was worth.*
la pièza, *the piece* (of cloth, etc.).
el estampadòr, *the printer.*
el impresòr, *the printer.*
èste (m.), èsta (f.), *this* (adj.).
èstos (m. pl.), èstas (f. pl.), *these* (adj.).
èsto, *this* (pron.).
èso, *that* (pron.).
aquèl, *that* (adj.).
¿ porqué ? *why ?*
entregàr, *to hand over, deliver.*
el bùlto, *the package* (bale, case).
tan, *so.*
dejàr, *to leave.*
anteayèr, *the day before yesterday.*
pasàdo mañàna, *the day after to-morrow* (literally, past to-morrow).
me, *me, to me.*
complacèr, *to please.*
ejecutàr, *to execute* (an order).
puèden (from podèr), *you* (pl. *they*) *can.*
el penìque, *the penny.*
mi (sing.), mis (pl.), *my.*
sabèr, *to know.*
sàben, *you* (pl., *they*) *know.*
el trabàjo, *the work.*
la yarda, *the yard.*
la mañàna, *the morning.*
tempràno, *early.*

Exercise 2

Translate into English:—

1. Pudièndo pedìr los nuèvos dibùjos. 2. No habíamos ofendìdo á Vs. 3. ¿ Hablarán Vs. hoy sòbre èste asùnto ? 4. Los estampadòres habían imprèso las circulàres anteayèr. 5. Dicièndo èsto, me ha entregàdo las muèstras. 6. ¿ Porqué había él dejàdo los dibùjos con nosòtros ? 7. Èllos habrán hècho èso pàra complacèr á sus clièntes. 8. Habré dìcho tòdo á él. 9. Vs. habrán dejàdo la nòta de pedìdo en màno de su cliènte. 10. Habrán cogìdo sin fàlta el tren de las nuève. 11. Si Vs. han ejecutàdo el pedìdo, puèden mandàr los bùltos hòy 12. Èsta tèla valía más de tres penìques la yàrda. 13. Vs. habrán seguìdo tòdas mis instrucciònes. 14. Habíamos pagàdo prècios mùy bàjos. 15. Hèmos vuèlto las pièzas èsta mañàna.

Translate into Spanish:—

1. We shall have returned the pieces the day after to-morrow. 2. What will you say if we have not paid the account ? 3. Where had he put the bills (of exchange) ? 4. Do you know whether the customers (clients) have returned all the pieces ? 5. By coming (tr.: Coming) early, he has done all this work. 6. Having returned this morning, he has sent the goods. 7. We had broken the eggs. 8. By ordering (tr.: Ordering) the goods the day before yesterday, we have received them (them we have received) to-day. 9. Had we told everything (all) to you ? 10. We have printed the circulars. 11. You (pl.) will have written the letters. 12. I shall have paid low prices. 13. Saying this, he has handed to you the patterns. 14. This cloth was worth more than (más de) four (cuatro) pence per (= the) yard. 15. Can you (pl.) meet (please *to*) the client ?

A. C.

Drawn by R. Caton Woodville.

TRIAL OF THE DEAD IN ANCIENT EGYPT,

where it was held that every man must survive an ordeal similar to that from which Osiris was believed to have emerged triumphant, in the judgment hall of Heliopolis, before he could be admitted to a life of bliss in the other world.

Continued from page 298.

GEOGRAPHY:

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AFRICA.—II

For the purposes of racial and commercial investigation Africa may conveniently be divided into five regions—the northern, the central or Equatorial, the eastern, western, and southern. A closer survey of these regions must, of course, necessitate many subdivisions in each, but as a simple index to the chief peculiarities of the continent, these five will probably serve as well as any others.

In accordance with this plan, the northern region of Africa consists of Egypt and the countries to the west of it, extending, roughly, to the north of latitude 20° N. In this division, from the anthropological point of view, Egypt must stand apart from the rest; for its inhabitants have little in common with the Berbers who predominate among the dwellers in the countries to the west.

In the Days of the Pharaohs

The Egyptians, as a matter of fact, are the direct descendants of the people of the Pharaohs, and, although many centuries of slave-raiding have introduced much negro blood into their country, this country may still be said to be inhabited by people of the Caucasian race. The language of all classes is Arabic, but the use of French is so common among the educated people that these can almost claim to be bi-lingual.

Egypt proper, the land of the agricultural Egyptians of to-day, consists, for all practical purposes, of that strip of country on either bank of the Nile which receives the benefits of that river's periodical inundations, and which supports its well-populated districts through its fertility. The betterment in the conditions of these agriculturists has been marked since the scientific distribution of the waters of the Nile has been taken in hand.

The remainder of this division of Northern Africa is made up of the Italian Protectorates of Tripoli and Cyrenaica, and the great stretches of French North-West Africa, Spanish Morocco, and the Native states.

With the exception of one or two stretches of the coast-line, the greater part of this vast region tends to be arid; speaking generally, its agricultural productiveness is due to irrigation rather than to rainfall. In the higher altitudes snow is by no means unknown. It is not universally realised, indeed, that in Algeria the heavy falls of snow in winter often cause great difficulties in the carrying on of the railway service. In Morocco the Atlas Mountains at some points attain to a height which exceeds 15,000 feet, and their summits are thus covered with snow all the year round.

Flora and Fauna

The vegetation of the fertile spots of North Africa is in many respects akin to that of Southern Europe. In these districts the cork-oak flourishes as abundantly as it does in the forests of Spain and Portugal. Other species of oak are frequently met with, and the rarer cedar is indigenous to some parts. Among the general flora are the olive, ilex, date and palmetto palms, and the aloe. As a proof of the broad range of plants to which the soil and climate lend themselves, it may be said that the northern holly consents to grow freely in certain spots.

The fauna of these regions has decreased very much both in variety and numbers. Centuries ago the lion abounded here, and, although the king of beasts is not yet entirely extinct, his appearances are very rare. Some other characteristic animals are the leopard, hyena, jackal, and antelope. A notable animal is the audad, or desert sheep, which is to be met with in many districts of North Africa, but principally to the south of the Atlas Mountains.

Turning now to West Africa, it will be found necessary to divide this main area into two sections—the Coast-Belt and the

Nigerian Sudan. In the latter division may be included the French Colony of Senegal, and the country stretching eastwards to the British possession of Northern Nigeria. To deal first of all with this Nigerian Sudan; although the climate here is naturally much hotter than that of North Africa, it is in general dry and fairly salubrious.

In many districts it is admirably adapted for pastoral and agricultural purposes. In other parts it is finely timbered, and its forest products play no small part in the wealth of its communities. Various crops are grown, of which the principal are cotton, maize, ground-nuts, sorghum, and pumpkins. The principal herds and flocks are those of cattle, sheep, goats, asses and horses.

The fauna comprises one of the largest species of giraffe, the lion, leopard, cheetah, hyena, hartebeest, various antelopes, reedbuck, gazelle, sabre-horned oryx, and the ostrich. Very few elephants remain.

The western forest belt extends from the south of the Gambia estuary to the neighbourhood of the Volta River in the British West Coast. After a short break its characteristics begin again on the borders of Southern Nigeria, whence they extend along the coast as far as the estuary of the Congo.

Inhospitable Regions

The obstacles that civilisation has met with in these inhospitable coast territories have been unusually hard to overcome, comprising, as they have, one of the most dense and impenetrable regions in the world, haunted by fevers utterly detrimental to the health of the white man, and inhabited by negroes whose hostility towards the intruder, whether Arab or European, found expression in flights of poisoned arrows. The efforts of the missionaries, chiefly British, American, and French, have at last begun to make some impression in the wilder parts, but the nature of the country must necessarily stand in the way of real rapidity in any progress of the sort.

The fauna of the Forest Belt is curiously varied, some of the most interesting specimens being met with in Liberia. Among these are the pygmy hippopotamus, the zebra antelope, the drill baboon, and the Diana monkey. Among the animals characteristic of the eastern portion are the gorilla and the okapi.

The next division to be considered is that of Central, or Equatorial, Africa. This includes the great basin of the Congo, and—necessarily very roughly—may be said to be bounded by the southern part of the Nile basin and by the Sudan on the north; by Lakes Tanganyika and Victoria Nyanza on the east, by Lake Bangweulu and Rhodesia on the south, and, of course, by the West African Coast District on the west.

The population of Central Africa is almost entirely negro, although in the north there is a distinct negroid element. It seems clear, indeed, that the inhabitants of these Northern Congo regions have in bygone ages been brought under the influence of Egypt. This is made evident in the pottery, arts, musical instruments, and even in the beliefs of the inhabitants of these equatorial lands, many of which recall those of the Egyptians of a past age.

East Africa

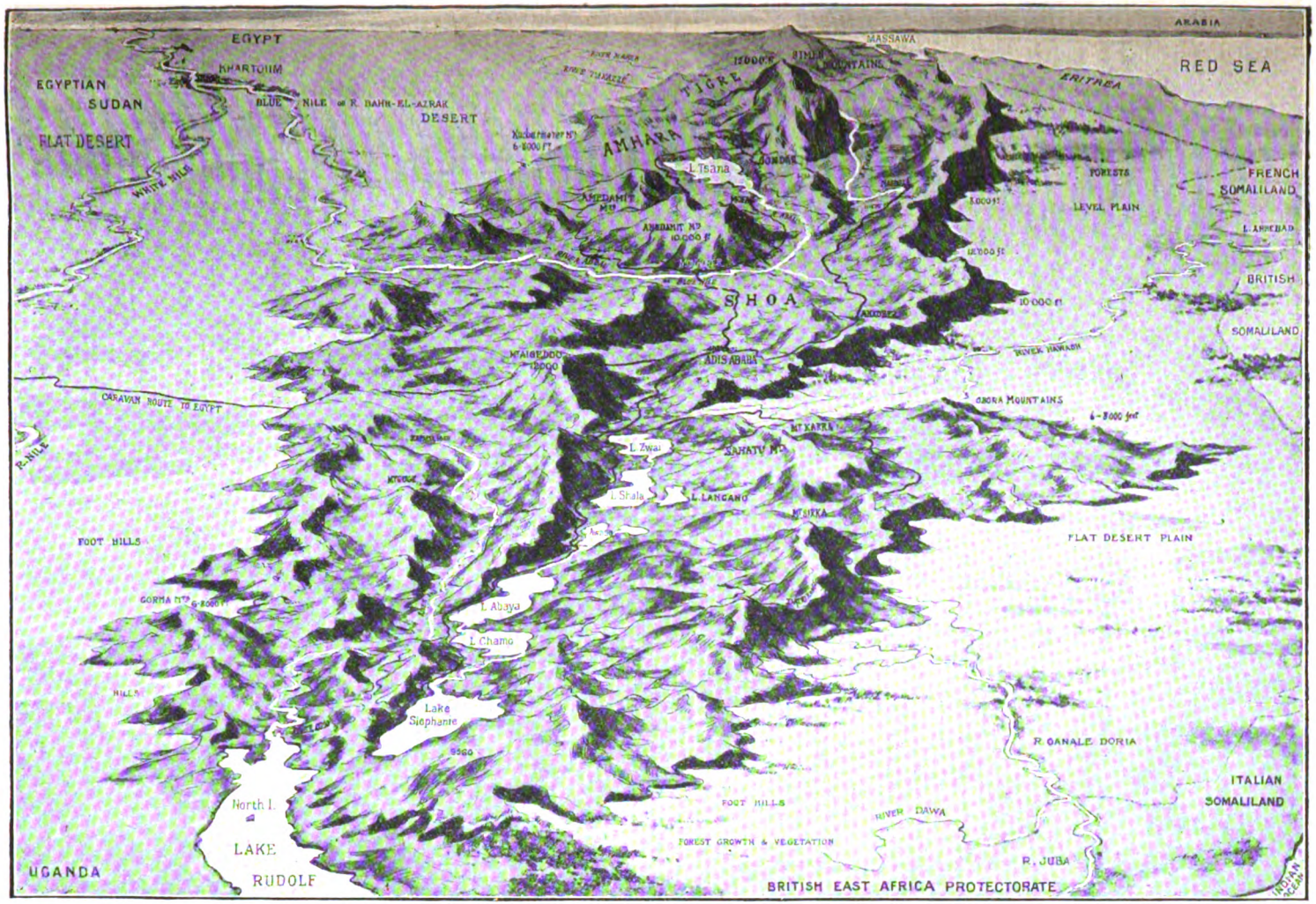
In the centre and south of this great Congo district the Bantu speech prevails. Some striking exceptions to the Bantu race, however, are to be met with here and there in the dense forests. These are the Pygmy folk, whose wild nature and tiny stature are now well known. These queer populations, though they never seem to be found to the west of the Cameroons, are met with in the Gabun, and in the centre, east, and north-east of Congoland, as well as in the Bahr-el-Ghazal.

On the whole, the civilisation of equatorial Africa may be regarded as of a distinctly low type. The taste for cannibalism, which was one of the most salient and horrible features of its degraded society, still prevails, although, of course, not in that wholesale and enthusiastic fashion which formerly characterised it.

The fauna of Central Africa closely resembles that of the west coast.

We may now turn to East Africa, which for the present purpose must be made to include Abyssinia, Somaliland, Galaland, British East Africa, and the region which ends, roughly, at the southern frontiers of "German" East Africa. Taking this somewhat heterogeneous collection of countries together, it will be seen at once that all this stretch of coast, compared with the moist shores of the west, is inclined to be arid, though this condition of affairs amends itself to the south of the equator.

Abyssinia, the northernmost of the countries forming this division, has a history which stands entirely apart from anything else of the kind in Africa. Although its original colonisation cannot vie in antiquity with that of Egypt, it is believed to have occurred more than 3,000 years ago, when a Semitic people from Arabia arrived on its



MAP OF ABYSSINIA,

showing the peculiar nature of the country, which is made up of a mass of volcanic rock set in a surrounding sea of sandy desert and level plains.

shores. These people adopted Christianity about the fourth century after Christ, and they have retained that religion from that time until the present day. Abyssinia is governed by an emperor surrounded by a court of no small pretensions, and supported by a sufficiently formidable army. Indeed, the country, which is a mass of volcanic rock set in a surrounding sea of sandy desert and level plains, is in itself a veritable fortress.

Northern Abyssinia and the hot, barren coast of the Red Sea include in their fauna the Nubian wild ass, the wild boar, desert sheep, and various species of gazelle. The lion is comparatively common both in Abyssinia and Somaliland, and elephants are still to be met with in the west of Abyssinia, more especially on the borders of the southern Sudan.

To the south of Somaliland, the landscape in British East Africa rapidly alters as the climate grows moister, and the soil becomes more fertile. Parts of the territories here, as well as in "German" East Africa, are mountainous, the altitudes in some places attaining to 10,000 feet.

We have now arrived at the last of these somewhat arbitrary divisions of the African continent—that of the south. In this may be included all the territories stretching to the south from the northernmost point of Rhodesia. Thus within this last division will come Portuguese East and West Africa, and the "German" territory of South-West Africa.

White Pioneers

The areas here which naturally evoke the greatest interest are those of British South Africa. These comprise the Cape of Good Hope, the Orange Free State, Natal, the Transvaal, and Rhodesia.

These southern lands of Africa differ from any others in the continent in that they are by nature adapted to the residence of the white man. There is no doubt that there is no healthier area in the world from this point of view. The climate, as a matter of fact, has triumphantly stood the test for more than two centuries and a half now; for the Dutch, who, succeeding the Portuguese explorers, became the first regular colonists, established themselves on the shores of Table Bay as early as 1650.

Since that time the white man has gradually spread his pioneers farther and farther inland, cultivating the soil as he went, until the discovery of rich diamond fields and gold mines and the development of railway enterprise hastened to a surprising extent the great colonising wave, and turned into important agricultural and industrial centres those lands which perhaps only a decade previously had known no other inhabitants than the lion, the antelope, the ostrich, and their various wild brethren.

So far as the white man is concerned, South Africa would seem to be especially favoured by the build of its territories. Speaking generally, it may be said that its soil rises in terraces from a coastal plain. The altitude of the land, moreover, tends to increase towards the north, and the loftiness of these territories has the effect of correcting the excessive heat which in other circumstances must inevitably prevail as the tropics are approached.

South Africa

It is mainly this reason, of course, that South Africa has developed into a number of important white communities, and, notwithstanding the large negro populations by which it is inhabited, has definitely become an area of European civilisation and progress. The edges of these various terraces are not a little remarkable, and were frequently mistaken for mountains by the early explorers advancing towards them across the coastal plain from the south.

The influence of these steadily mounting lands upon the climate of South Africa may be realised by a comparison of the mean annual temperatures of Cape Town and of Salisbury in Rhodesia. The mean annual temperature of Cape Town is 62·6° F.; that of Salisbury—nearly twenty degrees to the north of the first town—is 64·6° F., there being thus no more than a difference of two degrees between two places so widely separated in latitude! It is owing to this curious set of circumstances that it is possible to take a single mean temperature of the whole of British South Africa—a temperature which works out at the phenomenally low figure of 63° F.

The South African vegetation affords a considerable range of growths. On the whole it may be said that the area is exceptionally rich in blossoms, notwithstanding the naked aridity of the Kalahari Desert in the north—a barrenness which suffices to lower the very high average of growths elsewhere. One of the characteristic wild blossoms of the South African Veld is the arum lily, which blooms in extraordinary profusion here.

In many districts of South Africa—in those especially, it should be said, where the rainy season coincides with the winter—the climatic and floral features of the country strongly

suggest those of the European Mediterranean littoral.

Two characteristic growths of the Cape regions are the evergreen sugarbush and the "silver-tree," so called from its thick and glistening leaves, which have a curious appearance of silver.

One of the most typical kinds of South African landscape is that of the Veld. The Veld comprises the enormous grass stretches of the interior—great plateaux open to the sun and winds, that afford excellent pasture, and that support innumerable herds and flocks.

The Veld possesses its ornamental as well as its useful side; for after a season of rainfall an extraordinary wealth of flowers is wont to spring up on the upland plains themselves and on the Kopjes—curious elevations resembling in some respects the Tors of the Devon moors—by which their surface is broken here and there. One of the most prominent of these blossoms is the Arum lily already referred to.

Bush Veld

There are two types of Veld. The first is the High Veld, and this, as a matter of fact, is the one which has entered most freely into the popular imagination; the almost treeless grass stretches which correspond to the prairies of North America, and the *campo* of South America. But beyond this there is another kind of Veld, known as the Bush Veld. This is situated to the north of the other, and is far more liberally covered with trees and shrubs, among these being numerous thorn-bushes. One of the latter is the notorious "wacht-een-beetje"—the "wait-a-bit" thorn—the name of which sufficiently expresses the tearing propensities of the growth.

The native population of South Africa is both negro and negroid, and, although a variety of dialects obtain, the main speech is Zulu.

Bi-lingual States

But the native language is of less importance in South Africa than in any division of the continent, for the English and Dutch languages have taken a firm hold there. Dutch is the prevalent tongue in the Transvaal, Orange Free State, and in parts of Cape Town. As, however, English is also employed in these areas, they may be regarded as bi-lingual.

The English language is spoken elsewhere in South Africa, and the common employment of this speech has now extended as far to the north as—to give a necessarily rough estimate—latitude 10° S. A satisfactory circumstance is that the area in which its use prevails is steadily increasing. W. H. K.

ON LAKE BANGWEULU,

the great expanse of water, 2,500 square miles in area, which forms the head of the River Congo.

Continued from page 303.

MATHEMATICS:

Contributor: — ARITHMETIC, ALGEBRA, GEOMETRY, CO-ORDINATE GEOMETRY, TRIGONOMETRY, MECHANICS, MENSURATION, ETC.

(M. A. Lewenz, M.A.[Lond.]).

ALGEBRA.—XXIX

164. THE index of the power to which one number must be raised to produce a second number is called the **logarithm** of the second number with respect to the first as base. Thus if $a^x = y$ then x is called the logarithm of y to the base a and is written $\log_a y$.

Fundamental Properties of Logarithms

I. $\because a^0 = 1$ for all values of a $\therefore \log_a 1 = 0$.

Thus the logarithm of 1 *is* 0 *whatever the base may be.*

II. If $\log_a x = m$, $\log_a y = n$, $\log_a z = p$ .....
then $x = a^m$, $y = a^n$, $z = a^p$ .....
$\therefore xyz\ldots = a^m \times a^n \times a^p \ldots = a^{m+n+p+\cdots}$
$\therefore \log_a (xyz\ldots) = m + n + p + \cdots$
$= \log_a x + \log_a y + \log_a z + \ldots$

Thus the logarithm of a product is the sum of the logarithms of the factors.

III. If $\log_a x = m$ and $\log_a y = n$
then $x = a^m$, $y = a^n$ $\therefore \dfrac{x}{y} = a^{m-n}$

$\therefore \log \dfrac{x}{y} = m - n = \log_a x - \log_a y.$

Thus the logarithm of a quotient is the algebraic difference of the logarithms of the dividend and the divisor.

IV. If $x = a^m$ then $x^n = a^{nm}$
$\therefore \log_a x^n = mn = n \log_a x.$

Thus the logarithm of any power of a number is the product of the logarithm of the number and the index of the power.

V. Let $\log_a x = m$ and let $\log_b x = n$
then $x = a^m = b^n$ $\therefore a = b^{\frac{n}{m}}$, and $a^{\frac{m}{n}} = b$

$\therefore \dfrac{n}{m} = \log_b a$ and $\dfrac{m}{n} = \log_a b$

$\therefore \log_b a \times \log_a b = \dfrac{n}{m} \times \dfrac{m}{n} = 1.$

Again $n = m \log_b a$, but $n = \log_b x$ and $m = \log_a x$
$\therefore \log_b x = \log_a x \times \log_b a.$

Thus the logarithm of any number to the base b will be obtained by multiplying the logarithm of that number to the base a by a constant multiplier $\log_b a$.

165. To find a series for expanding a^x in powers of x.

Suppose we find a quantity such that $a^x = e^m$ where e has the value found in § 163.

Then $x \log_e a = m \log_e e = m$.

Hence $m = x \log_e a$

$$\therefore a^x = e^{x \log_e a} = 1 + x \log_e a + \frac{x^2}{2!}(\log_e a)^2 + \cdots + \frac{x^r}{r!}(\log_e a)^r + \ldots \quad \text{(vii)}$$

(expanding e by vi in § 163).

From vii we shall deduce the logarithmic series $a^x = [1 + (a - 1)]^x$.

If this be expanded by the binomial theorem, the series obtained will be convergent, provided $-1 < a - 1 < +1$.

Assuming this to be the case, we have

$$a^x = 1 + x(a - 1) + \frac{x(x-1)}{2!}(a-1)^2 + \ldots + \frac{x(x-1)(x-2)\ldots(x-r+1)}{r!}(a-1)^r + \ldots$$

Now arrange this series in ascending powers of x. Then

$$a^x = 1 + x\left[(a-1) - \frac{(a-1)^2}{2!} + \frac{(-1)(-2)(a-1)^3}{3!} + \ldots + \frac{(-1)(-2)\ldots(-r+1)}{r!}(a-1)^r + \ldots\right] + x^2[(a-1)^2 + \ldots\ldots] + \ldots\ldots$$

$$\therefore a^x = 1 + x\left[(a-1) - \frac{(a-1)^2}{2} + \frac{(a-1)^3}{3} - \ldots + (-1)^{r-1}\frac{(a-1)^r}{r} + \ldots\right] + x^2[\ldots.] + \ldots. \quad \text{(viii)}$$

Compare vii and viii. The absolute terms are the same.

$\therefore$ the coefficients of the various powers of x must be the same, otherwise the series would not be true for all values of x. Hence we can equate the coefficients of like powers of x.

Equating the coefficients of x in vii and viii we have

$$\log_e a = (a-1) - \frac{(a-1)^2}{2} + \frac{(a-1)^3}{3} - \ldots + (-1)^{r-1}\frac{(a-1)^r}{r} + \ldots$$

provided $-1 < a - 1 < +1$.

For a put $1 + z$, then

$$\log_e(1+z) = z - \frac{z^2}{2} + \frac{z^3}{3} - \ldots + (-1)^{r-1}\frac{z^r}{r} + \ldots \quad \text{(ix)}$$

provided $-1 < z < +1$.

Again change z into $-z$. Then

$$\log_e(1-z) = -z - \frac{z^2}{2} - \frac{z^3}{3} \ldots - \frac{z^r}{r} \ldots \text{(x)}$$

Subtract x from ix. Then

$$\log_e\left(\frac{1+z}{1-z}\right) = 2\left\{z + \frac{z^3}{3} + \ldots + \frac{z^{2p+1}}{2p+1} + \ldots\right\} \quad \text{(xi)}$$

It is sometimes more convenient to put xi in the following form: Let $z = \frac{m-n}{m+n}$, then

$$\log_e \frac{m}{n} = 2\left\{\frac{m-n}{m+n} + \frac{1}{3}\left(\frac{m-n}{m+n}\right)^3 + \ldots + \frac{1}{2p-1}\left(\frac{m-n}{m+n}\right)^{2p-1} + \ldots\right\} \quad \text{(xii)}$$

Now put $m = n + 1$, then

$$\log_e \frac{n+1}{n} = 2\left\{\frac{1}{2n+1} + \frac{1}{3}\left(\frac{1}{2n+1}\right)^3 + \ldots + \frac{1}{2p-1}\left(\frac{1}{2n+1}\right)^{2p-1} + \ldots\right\} \quad \text{(xiii)}$$

In xiii put $n = 1$ then

$$\log_e 2 = 2\left\{\frac{1}{3} + \frac{1}{3}\left(\frac{1}{3}\right)^3 + \ldots + \frac{1}{2p-1}\left(\frac{1}{3}\right)^{2p-1} + \ldots\right\}.$$

This enables us to calculate $\log_e 2$ to any degree of accuracy we like.

Having found the value of $\log_e 2$, put $n = 2$ in xiii.

Then $\log_e \frac{3}{2} = \log_e 3 - \log_e 2 = 2\left\{\frac{1}{5} + \frac{1}{3}\left(\frac{1}{5}\right)^2 + \ldots + \frac{1}{2p-1}\left(\frac{1}{5}\right)^{2p-1} + \ldots\right\}$.

Thus knowing $\log_e 2$ we can calculate $\log_e 3$ and so on.

For ordinary purposes we use logarithms to the base 10.

Having found $\log_e 3$ as indicated above, we find $\log_e 9$. For $\log_e 9 = \log_e 3^2 = 2\log_e 3$.

Knowing $\log_e 9$ we can calculate $\log_e 10$.

If we know $\log_e n$ where n is any number, we have $\log_e n = \log_{10} n \times \log_e 10 \quad \therefore \log_{10} n = \frac{\log_e n}{\log_e 10}$

Thus to find $\log_{10} n$ we multiply $\log_e n$ by $\frac{1}{\log_e 10}$

$\frac{1}{\log_e 10}$ is called the modulus of ordinary or common logarithms and is denoted by μ.

To find the value of the modulus:

$$\log_e 2 = 2\left[\frac{1}{3} + \frac{1}{3}\frac{1}{3^3} + \frac{1}{5}\frac{1}{3^5} + \ldots\ldots\right]$$

$$\left.\begin{aligned}
T_1 &= \frac{2}{3} &&= \cdot 666,666,667\\
T_2 &= \frac{2}{3^4} &&= \cdot 024,691,358\\
T_3 &= \frac{2}{5\times 3^5} &&= \cdot 001,646,091\\
T_4 &= \frac{2}{7\times 3^7} &&= \cdot 000,130,642\\
T_5 &= \frac{2}{9\times 3^9} &&= \cdot 000,011,290\\
T_6 &= \frac{2}{11\times 3^{11}} &&= \cdot 000,001,026\\
T_7 &= \frac{2}{13\times 3^{13}} &&= \cdot 000,000,097\\
&&&\overline{\cdot 693,147,171}
\end{aligned}\right\} \therefore \log_e 2 = \cdot 693147 \text{ correct to six places of decimals.}$$

Again $\log_e 3 - \log_e 2 = 2\left\{\frac{1}{5} + \frac{1}{3}\cdot\frac{1}{5^3} + \frac{1}{5}\cdot\frac{1}{5^2} + \ldots\ldots\right\}$

which will be found to equal $\cdot 405465$.

$\therefore \log_e 3 = \cdot 693147 + \cdot 405465 = 1\cdot 09861.$

$\therefore \log_e 9 = 2\log_e 3 = 2\cdot 19722$

$$\log_e 10 - \log_e 9 = 2\left[\frac{1}{19} + \frac{1}{3}\frac{1}{19^3} + \frac{1}{5}\cdot\frac{1}{19^5} + \ldots\ldots\right] = \cdot 10536$$

$\therefore \log_e 10 = \cdot 10536 + 2\cdot 19722 = 2\cdot 30258$

$\therefore \mu = \frac{1}{\log_e 10} = \cdot 43429.$

Thus we are enabled to calculate logarithms to the base 10.

Examples:—

(1) Show that when n is infinite, the limit of $\left(1 + \frac{x}{n}\right)^n$ is e^x

$$\mathrm{L}_{n=\infty}\left(1+\frac{x}{n}\right)^n = \mathrm{L}_{n=\infty}\left[1 + \frac{nx}{n} + \frac{n(n-1)}{2!}\left(\frac{x}{n}\right)^2 + \ldots + \frac{n(-1)\ldots(n-r+1)}{r!}\left(\frac{x}{n}\right)^r + \ldots\right]$$

$$= \mathrm{L}_{n=\infty}\left[1 + x + \frac{\left(1-\frac{1}{n}\right)x^2}{2!} + \ldots\ldots + \frac{\left(1-\frac{1}{n}\right)\left(1-\frac{2}{n}\right)\ldots\left(1-\frac{r-1}{n}\right)}{r!}x^r + \ldots\ldots\right]$$

Now when $n = \infty$ $\frac{1}{n} = 0$, $\frac{2}{n} = 0 \ldots\ldots \frac{r-1}{n} = 0 \ldots\ldots$

$$\therefore \mathrm{L}_{n=\infty}\left(1+\frac{x}{n}\right) = 1 + x + \frac{x^2}{2!} + \ldots + \frac{x^r}{r!} + \ldots\ldots = e^x.$$

(2) Find the sum of the infinite series.

$$1 + \frac{1}{2!} + \frac{1}{4!} + \frac{1}{6!} + \ldots\ldots + \frac{1}{2r!} + \ldots\ldots = S$$

We have $e = 1 + 1 + \frac{1}{2!} + \frac{1}{3!} + \ldots\ldots + \frac{1}{2r!} + \ldots\ldots$

also $e^{-1} = 1 - 1 + \frac{1}{2!} - \frac{1}{3!} + \ldots\ldots - \frac{1}{(2r-1)!} + \frac{1}{2r!} \ldots\ldots$

$\therefore e + e^{-1} = 2 + \frac{2}{2!} + \frac{2}{4!} + \ldots\ldots + \frac{2}{2r!} + \ldots\ldots$

$= 2\left(1 + \frac{1}{2!} + \frac{1}{4!} + \ldots + \frac{1}{2r!} + \ldots\right) = 2S$

$\therefore S = \frac{1}{2}(e + e^{-1})$.

(3) Show that $\log_e (x + n) = \log_e x + \log_e\left(1 + \frac{1}{x}\right) + \log_e\left(1 + \frac{1}{x+1}\right) + \log_e\left(1 + \frac{1}{x+2}\right) + \ldots\ldots + \log_e\left(1 + \frac{1}{x+n-1}\right)$.

$\log_e (x + n) = \log_e x\left(1 + \frac{n}{x}\right)$

$= \log_e x + \log_e\left(1 + \frac{n}{x}\right)$

Now $1 + \frac{n}{x} = \frac{x+n}{x} = \frac{x+1}{x} \cdot \frac{x+2}{x+1} \cdot \frac{x+3}{x+2} \ldots\ldots \frac{x+n-1}{x+n-2} \cdot \frac{x+n}{x+n-1}$

$\therefore \log_e\left(1 + \frac{n}{x}\right) = \log_e\left(1 + \frac{1}{x}\right) + \log_e\left(1 + \frac{1}{x+1}\right) + \ldots + \log_e\left(1 + \frac{1}{x+n-1}\right)$

$\therefore \log_e (x + n) = \log_e x + \log_e\left(1 + \frac{1}{x}\right) + \log_e\left(1 + \frac{1}{x+1}\right) + \log_e\left(1 + \frac{1}{x+2}\right) + \ldots + \log_e\left(1 + \frac{1}{x+n-1}\right)$.

(4) Show that $\log_e 2 = \frac{1}{2} + \frac{1}{1.2.3} + \frac{1}{3.4.5} + \frac{1}{5.6.7} + \ldots$

$\frac{1}{2} + \frac{1}{1.2.3} + \frac{1}{3.4.5} + \frac{1}{5.6.7} + \ldots$

$= \frac{1}{2} + \frac{1}{2}\left[\frac{3-1}{1.2.3} + \frac{5-3}{3.4.5} + \frac{7-5}{5.6.7} + \ldots\right]$

$= \frac{1}{2} + \frac{1}{2}\left[\frac{1}{1.2} - \frac{1}{2.3} + \frac{1}{3.4} - \frac{1}{4.5} + \frac{1}{5.6} - \frac{1}{6.7} + \ldots\right]$

$= \frac{1}{2} + \frac{1}{2}\left[\frac{2-1}{1.2} - \frac{3-2}{2.3} + \frac{4-3}{3.4} - \frac{5-4}{4.5} + \frac{6-5}{5.6} - \frac{7-6}{6.7} + \ldots\right]$

$= \frac{1}{2} + \frac{1}{2}\left[\frac{1}{1} - \frac{1}{2} - \frac{1}{2} + \frac{1}{3} + \frac{1}{3} - \frac{1}{4} - \frac{1}{4} + \frac{1}{5} + \frac{1}{5} - \frac{1}{6} \ldots\right]$

$= 1 - \frac{1}{2} + \frac{1}{3} - \frac{1}{4} + \frac{1}{5} - \frac{1}{6} + \ldots\ldots$

$= \log_e (1 + 1) = \log_e 2$.

166. Summation of Series.—Apart from the series already dealt with, a certain number can be summed, but it is impossible to give a general rule for their summation. The following will illustrate some of the methods employed. Very often the sum may be obtained by expressing the general term as the difference of two expressions, one of which involves $(n - 1)$ in the same way as the other involves n.

Thus in the series $\frac{a}{x(x+a)} + \frac{a}{(x+a)(x+2a)} + \ldots$ the general term $T_n = \frac{a}{[x + (n-1)a](x + na)} = \frac{1}{x + (n-1)a} - \frac{1}{x + na}$.

Hence the series may be rewritten

$\left(\frac{1}{x} - \frac{1}{x+a}\right) + \left(\frac{1}{x+a} - \frac{1}{x+2a}\right) + \ldots\ldots + \left(\frac{1}{x + (n-1)a} - \frac{1}{x + na}\right) + \ldots.$

Here all terms except the first and last cancel out

$\therefore S_n = \text{sum to } n \text{ terms} = \frac{1}{x} - \frac{1}{x + na}$.

167. *To find the sum of the squares of the first n natural numbers.*

Let $S_n = 1^2 + 2^2 + 3^2 + \ldots + n^2$.

Now $n^3 - (n-1)^3 = 3n^2 - 3n + 1$,

and changing n into $n - 1$ we have

$(n-1)^3 - (n-2)^3 = 3(n-1)^2 - 3(n-1) + 1$.

Similarly $(n-2)^3 - (n-3)^3 = 3(n-2)^2 - 3(n-2) + 1$

. . . . . .

$3^3 - 2^3 = 3 \cdot 3^2 - 3 \cdot 3 + 1$

$2^3 - 1^3 = 3 \cdot 2^2 - 3 \cdot 2 + 1$

$1^3 - 0^3 = 3 \cdot 1^2 - 3 \cdot 1 + 1$.

Adding the left- and right-hand sides of the above equations, we have

$n^3 = 3\{1^2 + 2^2 + 3^2 + \ldots + (n-1)^2 + n^2\} - 3\{1 + 2 + 3 + \ldots + (n-1) + n\} + n$

$= 3S_n - \frac{3n(n+1)}{2} + n$

$\therefore 3S_n = n^3 + \frac{3n(n+1)}{2} - n$

$\therefore S_n = \frac{n(n+1)(2n+1)}{6}$.

To find the sum of the cubes of the first n natural numbers.

Here $S_n = 1^3 + 2^3 + 3^3 + \ldots + n^3$.

We have $n^4 - (n-1)^4 = 4n^3 - 6n^2 + 4n - 1$

Similarly $(n-1)^4 - (n-2)^4 = 4(n-1)^3 - 6(n-1)^2 + 4(n-1) - 1$

$(n-2)^4 - (n-3)^4 = 4(n-2)^3 - 6(n-2)^2 + 4(n-2) - 1$.

. . . . . .

$3^4 - 2^4 = 4 \cdot 3^3 - 6 \cdot 3^2 + 4 \cdot 3 - 1$

$2^4 - 1^4 = 4 \cdot 2^3 - 6 \cdot 2^2 + 4 \cdot 2 - 1$

$1^4 - 0^4 = 4 \cdot 1^3 - 6 \cdot 1^2 + 4 \cdot 1 - 1$

From the picture by Ernest Crofts, R.A.; by permission of Messrs. S. Hildesheimer, Ltd.

KING CHARLES I. ON HIS WAY TO EXECUTION, JAN. 30, 1649.

The king was accused of having tried to destroy the liberties of the people and of being a tyrant, a traitor and murderer. He refused to answer the charges, denying the authority of his judges. Sentence of death was pronounced against him; and he was executed in front of the Banqueting House at Whitehall.

Adding, $n^4 = 4S_n - 6(1^2 + 2^2 + \ldots + n^2) + 4(1 + 2 + \ldots + n) - n$

$= 4S_n - n(n+1)(2n+1) + 2n(n+1) - n$

$\therefore 4S_n = n^4 + n + n(n+1)(2n+1) - 2n(n+1)$

$= n(n+1)(n^2+n)$

$$\therefore S_n = \frac{n^2(n+1)^2}{4} = \left\{\frac{n(n+1)}{2}\right\}^2.$$

Thus the sum of the cubes of the first n natural numbers equals the square of the sum of those numbers.

Exercise 39

(1) Show that when n is infinite the limit of $\left(1 + \frac{a}{n}\right)^{\frac{a}{b}}$ is $e^{\frac{a}{b}}$.

(2) Show that $e^{-1} = \frac{2}{3!} + \frac{4}{5!} + \frac{6}{7!} + \ldots$.

(3) Show that $\log_e 3 - \log_e 2 = \frac{1}{2} - \frac{1}{2.2^2} + \frac{1}{3.2^3} - \frac{1}{4.2^4} + \frac{1}{5.2^5} \ldots$.

(4) Show that $\frac{e^2+1}{e^2-1} = \left\{1 + \frac{1}{2!} + \frac{1}{4!} + \frac{1}{6!} + \ldots\right\} \div \left\{1 + \frac{1}{3!} + \frac{1}{5!} + \frac{1}{7!} + \ldots\right\}$

(5) Show that $\log_e \sqrt{12} = 1 + \left(\frac{1}{2} + \frac{1}{3}\right)\frac{1}{4} + \left(\frac{1}{4} + \frac{1}{5}\right)\frac{1}{4^2} + \ldots$.

(6) Show that $\log_e \frac{x}{x-1} = 2\left\{\frac{1}{2x-1} + \frac{1}{3}\frac{1}{(2x-1)^3} + \frac{1}{5}\frac{1}{(2x-1)^5} + \ldots\right\}$.

(7) Show that $1 + \frac{2^2}{2!} + \frac{3^2}{3!} + \frac{4^2}{4!} + \ldots = 5e$.

(8) Show that the sum of n terms of the series $1.2 + 2.3 + 3.4 + \ldots + n(n+1) = \frac{1}{3}n(n+1)(n+2)$.

(9) Show that the sum of n terms of the series $\frac{1}{1.2} + \frac{1}{2.3} + \frac{1}{3.4} + \ldots + \frac{1}{n(n+1)} = 1 - \frac{1}{n+1}$

(10) Show that the sum to infinity of the series $\frac{3}{1^2.2^2} + \frac{5}{2^2.3^2} + \frac{7}{3^2.4^2} + \ldots + \frac{2n+1}{n^2(n+1)^2} + \ldots = 1$.

(11) Show that the sum of n terms of the series $\frac{1}{1.3} + \frac{2}{1.3.5} + \frac{3}{1.3.5.7} + \ldots + \frac{n}{1.3.5\ldots(2n+1)} = \frac{1}{2}\left\{1 - \frac{1}{1.3.5\ldots(2n+1)}\right\}$

Key to Exercise 38

(1) 9·8995. (2) 10·0100. (3) 5·0010. (4) $\frac{2}{3}\left(1 + \frac{x}{24}\right)$.

(5) $1 + \frac{3}{2}x$. (6) $\frac{1}{6}r(r+1)(r+2)$. (7) $\sqrt{\frac{2}{3}}$.

(8) $\sqrt{8} - 1$. (9) $3\sqrt{3}$.

M. A. L.

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MECHANICS.—VI

32. **Kinetics.**—We now turn from the geometrical consideration of motion to the study of motion with reference to the body moving.

Mass is defined as quantity of matter. We measure the quantity of matter in a body by the amount of force required to move it, since it is reasonable to assume that a larger force is required to set in motion, or bring to rest, a greater quantity of matter than is needed for a smaller quantity.

Mass depends not only on size but on density. If we have two bodies of the same volume, one of wood and one of iron, we shall find that a greater force is required to move the iron than the wood. Hence we say that the mass of the piece of iron is greater than that of the piece of wood, and since they are of the same size, that the **density** of iron is greater than that of wood.

It is common knowledge that force must be exerted to set matter in motion or bring it to rest, and that all material bodies resist such a change of motion. For instance, if you try to push open a heavy swing door, the door will resist until you exert sufficient force to overcome its resistance; similarly, if you try to stop a heavy body rolling down a hill it will resist your efforts until you exert sufficient force to overcome its resistance.

This property which is inherent in all matter is called **Inertia.**

33. **Newton's Laws of Motion.**—Before stating and examining these in detail we shall do well to be quite clear on the point of what is meant by a natural law. Such a law is not an arbitrary rule which must be obeyed—indeed the term law is somewhat misleading. Laws, in the scientific sense, are nothing but descriptions of what takes place in nature. Thus Newton, after studying the way matter behaved, summed up the results of his observations in short descriptions which we call laws. For instance, Newton's law of gravity states that bodies attract one another in proportion to their masses and in inverse proportion to the square of their distances. It is well to realise that this is not an explanation, but merely a description; it does not tell us what the force of gravity really is, or how it acts. We cannot even prove its truth; but what we can prove is that, if bodies did attract one another in the way the law states, they would behave exactly as we find by experience they do behave.

34. **First Law.—Every body perseveres in its state of rest or of uniform motion in a straight line, except in so far as it is made to change that state by external forces.**

This is sometimes called the **Law of Inertia.** By taking a standard of mass the piece of platinum weighing a pound, or the cubic centimetre of water at 4° centigrade weighing a gram, we may measure the mass of any body by finding what mutiple or fraction of the force required to move the standard mass a certain distance is required to move the body under consideration through the same distance.

We have to apply the force to overcome the inertia of the body.

Since the mass of a body depends on its volume and its density, we may define mass as the product of its volume and its density; i.e. $m = v \times d$ or to put it differently $d = \frac{m}{v}$

35. **Momentum** is defined as the product of the mass and the velocity of a body; i.e. $M = mv$.

The unit of momentum is the momentum of unit mass moving with unit velocity.

Thus unit momentum in the F. P. S. system is the momentum of a mass of 1 lb. moving with a velocity of 1 foot per sec., and is called one-foot-pound-second $\left(1 \text{ lb.} \frac{\text{ft.}}{\text{sec.}}\right)$

In the C. G. S. system it is one gram-centimetre-second $\left(1 \text{ gm.} \frac{\text{cm.}}{\text{sec.}}\right)$, i.e. the momentum of a mass of 1 gram moving with a velocity of 1 centimetre per second.

Example:—

Find the momentum of a mass of 2 lb. after falling for 15 minutes.

After 15 minutes $v = gt = 32 \times 15 \times 60$

$\therefore$ Momentum $M = 2 \times 32 \times 15 \times 60 = 57{,}600$ F. P. S. units.

We may look upon momentum as the "quantity of motion" which a body possesses.

36. **Second Law.—Change of motion is proportional to the impressed force, and takes place in the direction in which the force acts.**

Suppose a force F acts on a mass m for a given time t. It will generate a certain quantity of motion or momentum in the mass. If now this same force acts during the same time on a larger mass, the latter will move with a smaller velocity than the first mass, but the momentum generated will be the same in each case and we shall have $m_1v_1 = m_2v_2$ where m_1 and v_1 stand for mass and velocity in the first case, and m_2v_2 for mass and velocity in the second case.

If the force be applied for a longer time, the momentum generated will be proportionately greater. Thus force may be measured by the momentum generated in unit time.

Hence if a force F generates a momentum M in seconds, it will generate a momentum $\frac{M}{t}$ in 1 second. Therefore we measure force thus:

$$F = \frac{M}{t} = \frac{mv}{t} = ma \left(\text{since } a = \frac{v}{t}\right)$$

This is the most convenient form in which to define force, and is called the fundamental kinetic equation: **Force = Mass × Acceleration.**

In F. P. S. units, unit force is that which will cause a mass of 1 lb. to move with an acceleration of 1 $\frac{\text{ft.}}{\text{sec.}^2}$ after acting on it for 1 second.

This unit is called a **poundal.**

In C. G. S. units, the unit of force is called a **dyne.**

The equation $F = ma$ may also be written $a = \frac{F}{m}$, which shows us that when a force F acts on a mass m, the acceleration produced equals the ratio of the force to the mass.

Since $F = ma$ $\therefore$ $Ft = mat = mv$

Now suppose a body of mass m is moving with a velocity v, and a force F acts on it for a time t, the result will be that the body will have a velocity, v_2 after t seconds. The acceleration a due to the impressed force $= \frac{v_2 - v_1}{t}$

Hence $Ft = mat = m(v_2 - v_1)$

Now Ft is called the **impulse**, and $m(v_2 - v_1)$ clearly = **change of momentum.** Hence the second law of motion has been restated as follows:

The change of momentum of a body is equal to the impulse which produces it, and is in the same direction.

We may further derive the following definitions:

Equal forces are those which generate in the same mass equal velocities in equal times.

Equal masses are those in which equal forces generate equal velocities in equal times.

37. The **poundal** and the **dyne** are usually called dynamical or absolute units of force. We shall deal later, in connection with statics, with the gravitational measures of force.

1 poundal = 13,829 dynes approximately.*

38. **Third Law.—Reaction is equal and opposite to action—i.e. the actions of two bodies on each other are always equal and tend in opposite directions.**

This is sometimes put as follows: **Action and reaction are equal and opposite.**

By action we mean the force one body exerts on another, and by reaction we mean the force which the second exerts on the first. Thus, if you press your hand on the table, your hand is pressed by the table. Or if you pull a heavy weight along by a rope, the weight tends to pull you back, or, in other words, tends to impede your forward motion.

The second case may present slight difficulty, but it is clear that the action and reaction must be equal and opposite, otherwise the rope would become slack and either the weight would move towards the person pulling or vice versa. The motion forwards of the whole system, weight and puller, is due to the reaction in a forward sense of the ground, on which the person pulling exerts a backward pressure with his feet.

When the action and reaction of two bodies tends to keep them apart we have what is called a **thrust**

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* A poundal acting on 1 lb. for 1 sec. produces a velocity of 1 $\frac{\text{ft.}}{\text{sec.}}$. Now 1 lb. = 453·7 gm. and 1 ft. = 30·48 cm. approximately $\therefore$ 1 poundal acting on 453·7 gm. produces a vel. of 30·48 $\frac{\text{cm.}}{\text{sec.}}$

$\therefore$ Momentum imparted by 1 poundal = 453·7 × 30·48 C. G. S. units = 13,828·8 C. G. S. units approximately.

Now 1 dyne imparts 1 C. G. S. unit of momentum in 1 sec.

$\therefore$ 1 poundal = 13,829 dynes approximately.

or **push.** Thus if a piece of rubber is squeezed between pincers, the sides of the rubber exert a pressure on the pincers which tends to thrust them apart.

Again when the action and reaction of two bodies tends to draw them together or prevent them from moving apart, we have what is called a **tension** or **pull.** Thus if two bodies are joined by a piece of stretched elastic, this tends to pull them together.

The above considerations should make it clear that forces always occur in pairs between two bodies. If a man walks with outstretched hand, his hand will exert no force except the little force required to overcome the friction of the air. But if his hand comes in contact with a heavy body, it will exert pressure on that body and will immediately call into existence an equal and opposite pressure of the body on the hand.

When the action and reaction between two bodies tends to prevent them from sliding, one along the other, we have what is called **Friction.**

Thus when we walk we start by pressing *backwards* on the ground, and the reaction of the ground, due, in a *forward* direction, to friction, sets us in motion.

39. We have seen that force may be measured by change of momentum. The third law states that the rate of change of momentum of two bodies is equal and opposite (since this rate of change of momentum is due to action and reaction). Hence if the momentum of one body increases in one direction, the momentum of the other will decrease in that direction at the same rate (i.e. it will increase in the opposite direction); therefore if we adopt the convention used for velocities and accelerations, with regard to sign, calling the momentum in one direction positive and that in the opposite direction negative, we see that the algebraic sum of momenta due to action and reaction is constant. This holds good for any number of bodies. This is sometimes called the **Principle of the Conservation of Momentum** and may be stated thus:

The total momentum of a system of moving bodies in any direction is not changed by the mutual actions and reactions of the bodies.

This also follows from the First Law of Motion.

Example:—

The Recoil of a Gun.—If a gun be fired, the explosion of the charge imparts equal and opposite momenta to the shot and the gun. Hence if the speed of the shot be given, the speed of the recoil can be found.

A shot weighing 10 lb. is discharged from a gun weighing 10 tons. The shot escapes from the gun with a velocity of 2,000 $\frac{\text{ft.}}{\text{sec.}}$, $\frac{1}{5}$ths of a second after the powder is fired. Calculate the velocity of the gun at the instant the shot leaves it, assuming that its motion is unimpeded. What average force would it be necessary to exert upon the gun to keep it from changing its position during the discharge? (London Matric. Exam.)

Let v = velocity of gun.

Total momentum of shot and gun is unaltered by the discharge.

$\therefore 10 \times 2{,}240v + 10 \times 2{,}000 =$ momentum before discharge $= 0$

$$\therefore v = -\frac{200}{224}\frac{\text{ft.}}{\text{sec.}} = -\frac{25}{28}\frac{\text{ft.}}{\text{sec.}}$$

i.e. the gun recoils with a velocity of $-\frac{25}{28}\frac{\text{ft.}}{\text{sec.}}$

The average acceleration $a = \frac{v}{t} = \frac{25}{28} \div \frac{4}{5}$

$$= \frac{125 \text{ ft.}}{112 \text{ sec.}^2}$$

$\therefore$ average force acting on the gun $= ma$

$$= 10 \times 2{,}240 \times \frac{125}{112} \text{ poundals} = 25{,}000 \text{ poundals}$$

$\therefore$ an average force of 25,000 poundals would be required to keep the gun from changing its position.

40. **Impact.**—If a body A strike another body B, the action between A and B is equal and opposite, i.e. the momentum which A loses equals that which B gains.

Suppose two bodies A and B are moving with velocities v_1 and v_2 in the same direction, and A overtakes B; then if the bodies are inelastic they will move on together with a common velocity u.

If the mass of A be m_1 and the mass of B be m_2 then momentum of A $= m_1v_1$ and momentum of B $= m_2v_2$

$\therefore m_1(v_1 - u) = m_2(u - v_2)$

$\therefore (m_1 + m_2)u = m_1v_1 + m_2v_2$

since total momentum after impact = total momentum before impact $\therefore u = \frac{m_1v_1 + m_2v_2}{m_1 + m_2}$

If the bodies are moving in opposite directions, i.e. if B moves with a velocity $-v_2$ then $u = \frac{m_1v_1 - m_2v_2}{m_1 + m_2}$

When a bat strikes a ball, or a hammer a nail, we have a case of **impulse.** This is usually a case of impact in which the motion of one of the bodies is restrained after the blow, by some external force.

Exercise 7

(1) How long must a force of 8 poundals act on a 20 lb. mass to change its velocity from 2 $\frac{\text{ft.}}{\text{sec.}}$ to 26 $\frac{\text{ft.}}{\text{sec.}}$?

(2) A body acted on by a horizontal force of 8 poundals moves horizontally 10 ft. in 2 seconds. Find the mass of the body.

(3) A mass of 1 kilogram, starting from rest, acquires a velocity of 1 $\frac{\text{metre}}{\text{sec.}}$ after moving over a distance of 1 metre. Find the force acting on the mass.

(4) A force of 32 poundals acts on a mass of 16 lb. Find the time taken to pass through 100 ft. from rest, and the space described in the 5th second of motion.

Key to Exercise 6

(1) 900 ft., 1,800 ft.; 3 sec. (2) 20 ft
(3) horizontal: $2\frac{1}{2}$ sec. 3,000 ft., 100 ft.
angle of 45°: 53 sec. 45,000 ft., 11,350 ft.
angle of 60°: 65 sec. 39,000 ft., 16,975 ft.
angle of $-30°$: $\frac{1}{6}$ sec. 173 ft., 100 ft.
(4) 75·02 yds. east of the ship. **M. A. L.**

Continued from page 307.

ART AND MUSIC:

***Contributors*:—THE THEORY OF ART (Hon. John Collier; J. G. B. Lynch). DRAWING AND PAINTING (J. G. B. Lynch). THE THEORY OF MUSIC (R. R. Terry, Mus.Doc., F.R.C.O.; Hubert Grant).**

ARCHITECTURAL DRAWING

ARCHITECTURE is the art of constructing and beautifying buildings according to certain specified rules, so that the term architectural drawing includes every kind of drawing which may have to be called into requisition, in order to carry out this work.

The word architect, by the way, is derived from two Greek words which, translated literally, mean "chief worker."

In treating with the subject of architectural drawing, it will be advisable to divide our course of instruction into a number of distinct sections. In determining the sequence of these divisions, we shall be guided by the needs of the students, and propose to begin by giving some practical advice upon the various kinds of papers, and the different instruments that are required by the architectural draughtsman.

Material Required and—

In choosing drawing paper, examine carefully the surface, which should be smooth for line work. Lining paper, which is quite cheap, will serve your purpose admirably.

For early practice, you should confine your efforts to line drawing without attempting colour. In your initial attempts, you are likely to use the rubber rather freely; a very smooth surface is therefore inadvisable, as it is liable to be destroyed; consequently your lines will have a woolly appearance. The two kinds of paper most generally used are "Whatman's hot pressed" and "not." By the word "not" we mean "not hot pressed." This latter does not possess such a smooth surface, and is therefore more suitable for drawings, which you intend to tint in flat or graduated colours.

Whatman's papers are expensive, so for your first effort cartridge paper will be quite good enough to practise upon, and although its surface does not allow very frequent use of the rubber, it takes the colour well. As this make of paper is manufactured in continuous rolls of 60 in. in width, it is most suitable for drawings of very large dimensions: its chief fault being that after a time, however, it is apt to crack and tear.

When learning to trace, ordinary tracing paper is most suitable. Tracing linen is used for more advanced work which has to stand hard wear.

As regards purchasing drawing instruments, you will need very few at first, but it is advisable to buy the best quality, for if they are well-made they will last you a life-time: and it is impossible to obtain the necessary accuracy if your compasses and bows have legs of uneven length, or blunt points, or work stiffly in their joints.

Your first investment should include the following:—

(1) Dividers.
(2) Half set compasses with ink and pencil points, and lengthening bar.
(3) Pencil and ink bows for executing small curves. These should be double-jointed.
(4) Two ruling pens, in varying degrees of fineness.
(5) Scales in box-wood or ivory.
(6) T squares.
(7) Set squares.
(8) A drawing board.
(9) Etching pens for freehand work.
(10) Drawing pins.

Having obtained your instruments we will now proceed to explain the manner in which they should be used.

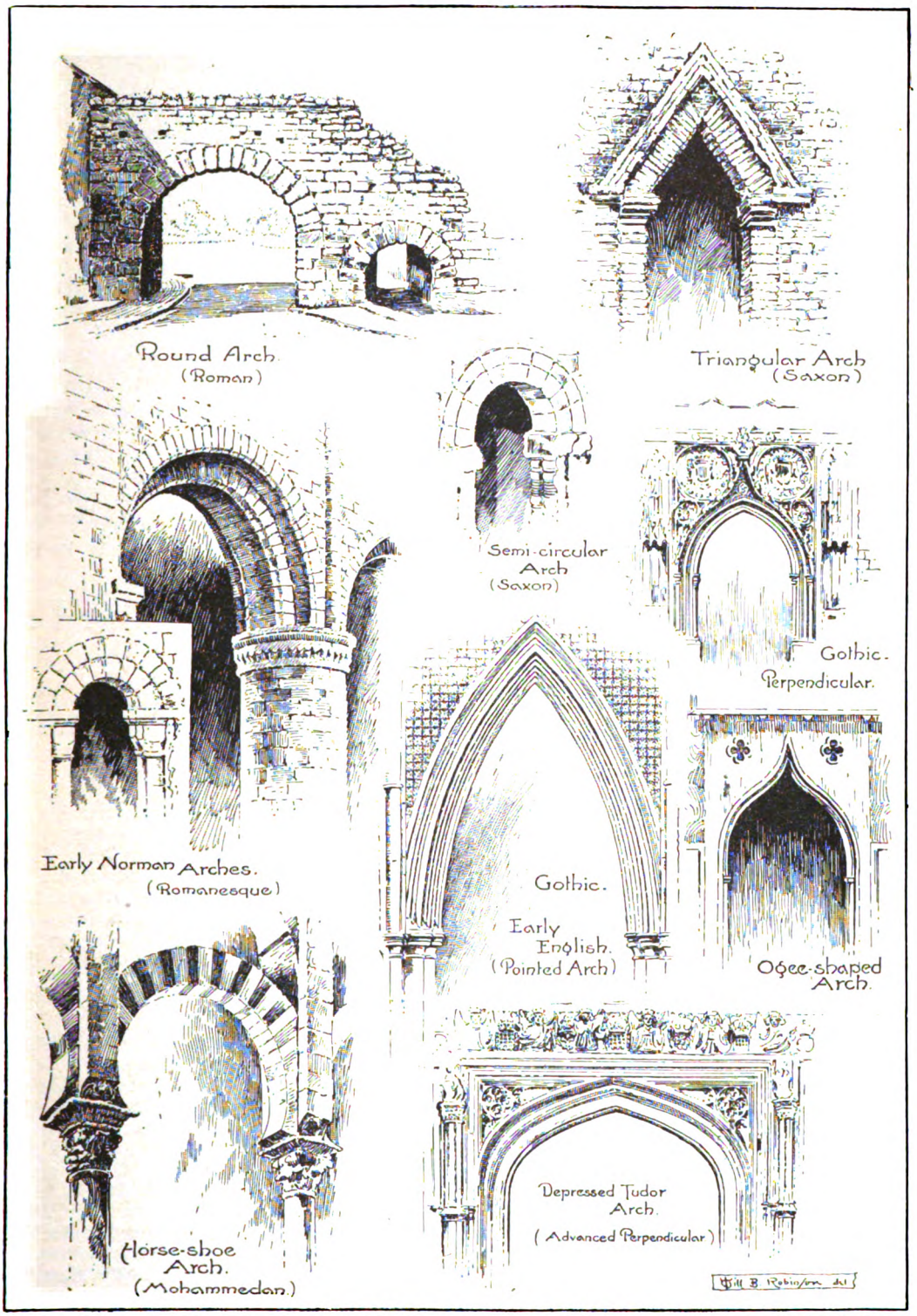
—How to Use It

First of all, place your drawing board upon a slanting desk, so that you will be able to obtain a direct view of your work. If the board lies flat on the table you will be apt to look at your drawing in a slanting manner, and in consequence everything will be foreshortened.

If a suitable desk is not available, raise the back of the drawing board. Let it rest at a convenient angle, in order to ensure that when the head is bent in its natural position you will have a direct view of your drawing paper.

For simple outline drawings, fix your paper on the drawing board by means of drawing pins. This method, however, has one great disadvantage. Occasionally the heads of the pins prevent the free use of the scale, set square, or T square. Another and perhaps more satisfactory way is to strain and mount the paper on the board. In the case of drawings, which you intend to tint or colour, this plan must always be adopted, in order to prevent the paper from cockling.

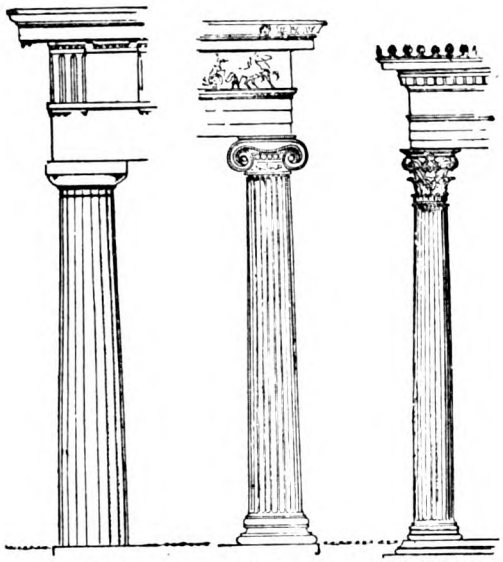
It is hardly necessary to impress upon you the necessity of seeing that the cross-piece of the



Drawn by W. B. Robinson.

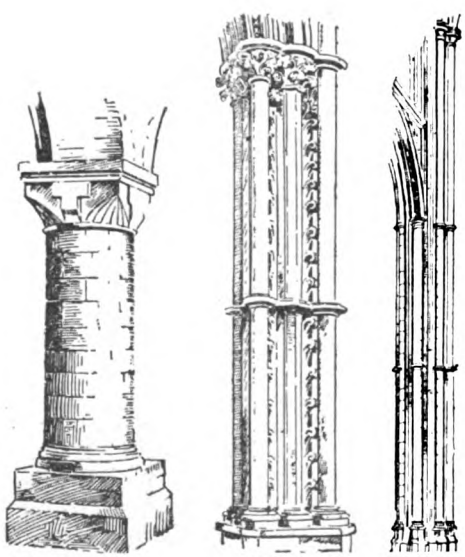
THE VARIOUS FORMS OF ARCHES

can easily be distinguished and compared by means of the above drawings, which should also prove full of suggestion to the architectural artist.



THREE GREEK ORDERS

in which the shafts tapered from the bottom towards the top. A tapering shaft tends to look concave. To correct this illusion the classic columns had an *entasis* or increment about one third of the way up the shaft.



Drawn by W. B. Robinson.

ROMANESQUE AND GOTHIC TYPES

were of the same diameter at the top as at the bottom. The Tower of London affords good examples of the Norman Pillar; the choir of Lincoln Cathedral of the Early English, and the nave of Canterbury Cathedral of the Perpendicular.

T square is held firmly pressed to the side of the drawing board, or that the set square lies solidly on the arm of the T square.

In using the compasses train yourself to force the needle point into the paper with sufficient pressure to prevent it slipping. In order to accomplish this successfully, you will have to cultivate the art of handling the instrument delicately yet firmly; the necessity for this delicacy in execution will be very apparent in cases where you have to draw a number of circles or arcs from the same centre, which of course frequently occurs.

You must be guided as to the thickness of the line by the scale of the drawing, and the style of the work upon which you are engaged. A very thick line necessitates greater care in drawing than a thin one. Further, a very thick line is often misleading, as it suggests heavier work than is intended, but at any rate it will give breadth and simplicity to a design. A very thin line, on the contrary, is apt to lead one to suggest more detail than the character of the design requires.

In Greek or Renaissance work, the finer line is used more frequently than in Gothic. One cannot of course lay down any definite rule; the draughtsman must use his own discretion.

Not only must you learn to copy accurately various designs, but your preliminary training must include the projection in plan and elevation of solids.

Classic Models

After mastering these simpler forms, you may pass on to the classic orders, which constitute the best models for beginners, because the column of each order is constant in its proportion.

Some time ago the practice of back-lining was almost universally used in architectural drawing. This custom has, however, entirely disappeared.

Back-lining consisted in drawing a line of double thickness under and on the right side of any projecting feature, in order to suggest a shadow. The practice had several disadvantages: a projection of a few inches would have a back line of exactly the same thickness as one of two or three feet, which of course was misleading, and gave a wrong impression. It also made the drawing mechanical.

Instead of drawing all the lines of a moulding with a ruler, it is often more effective to carry through the first few only in this manner, the rest of the lines being indicated at their meeting points or where another moulding cuts them short.

The best way to obtain the effect of a high light in an outline drawing when the lines meet the surface which catches the full light is to cut the line short before it reaches this surface. Whenever a mechanical drawing represents a building with more than one plane, the plane nearest the eye, or, in other words, the foreground, should be ruled in strongly, and for those further distant a lighter line should be employed, or, in the case of an ink drawing, a lighter colour may be used with advantage to indicate the receding portion. The lighter coloured ink will in no way destroy its value as a true representation, but will add to its artistic effect.

J. G. B. L.

FIREPLACES

One of the most distressing features of modern inventions which make for convenience is the ease with which this mere convenience subjugates a fine ideal in the individual. How often do we hear it said: "Oh, I know it's ugly, but think of the trouble it saves!" This is perpetually repeated of all sorts and conditions of household arrangements, but is particularly applicable to the case—the abhorrent case—of gas fires.

Now there is no gainsaying the fact that gas fires are convenient, that they do save trouble: neither will any person of taste dispute their ugliness, both in themselves and in their inspiration. How much better it is to make a small concession now and again to an ideal and cherish it, even if your convenience suffer.

This leads to the honest fireside, to the light flames which burst from coal or wood, to the smoke which may cause dirt in a room but which does not consume the oxygen in the air. Here modern "improvement" is really improvement, for modern grates have been devised which throw all the heat from a small fire outwards to warm the room, not upwards to the chimney as is the case with many older grates. But our purpose for the moment is to discuss the outward appearance of fireplaces. Here modernity is divided about equally between good and bad.

Open Hearths

There is an enormous variety of fireplaces from the high and wide open hearth of some historic stronghold to the little plain black registered grate which forms the comfort of the small suburban bedroom.

The open hearth is, perhaps, the most attractive in appearance from association because it is old in design (if you are not so fortunate as to live in a house where it is also old in execution), and, moreover, it gives the opportunity of using some ancient cast-iron fire-back behind the blaze, and fire-dogs of polished steel before. Here the sides of the hearth are often enclosed by old, worn stone-work with a wide arch, possibly embellished with heraldic carvings.

The overmantel may be also of marble or of rougher stone, or else of carved oak panelling, matching or at all events harmonising with the panelling upon the rest of the walls. Here—to return to domestic utility which should never be quite lost sight of in any art—a very big fire is necessary: the open fire is an extravagant one. You must needs put big logs upon it and keep it constantly replenished if you are to derive any heat from it for a fair-sized or large room.

Then, of course, there is the charming fireplace, frequently introduced into modern designs for household architecture; this consists of an archway, often perfectly semi-circular and made of red brick—either rough ordinary brick or highly-glazed and polished material. The rough sort is certainly preferable. In this archway there may be bars for an ordinary grate with a back which slopes towards the room to throw out the heat; or there may be just an open space with a small grating below to allow of a draught to attack the blaze.

Dutch Tiles

Of the more usual grates each and every type is capable almost of artistic treatment, but these simpler forms given above best lend themselves to the ordinary room in which people live and eat and rest. The fireplace with a brass or beaten copper hood is very customary at the present time and it may be attractive enough, if vigorous simplicity is employed in all that immediately surrounds it.

The next point which the artist deals with in the question of fireplaces is the tiles, which, at all events in modern grates, form an indispensable adjunct. Plain tiles of a good colour, harmonising with the principal colour of the room are agreeable, but naturally the collector will have his eye and heart set upon tiles of an old Dutch kind or even Persian. The Dutch were the most prolific designers of tiles, and used them very largely.

Some of our own artists have given years of work to the designing of these, and the tiles executed from the drawings of the late Walter Crane will long be cherished by collectors who care for the classical scheme of subject and interpretation in blue and white. The present writer has seen valeric plaques, mounted in the wooden sides of the chimney-piece, used with delightful effect. But the valeric ware has the disadvantage of being extremely brittle, and the least considerable jar will sometimes shiver the plaque into fragments. The beautiful iridescent bluish green colour is well worthy of special attention and the utmost care in safeguarding. J. G. B. L.

Continued from page 312.

BUSINESS AND COMMERCE:

***Contributors*:**—BOOK-KEEPING (Frederick Heelis, F.C.I.S.). SHORTHAND (by arrangement with Pitman's Schools). COMMERCIAL TRAINING (Arthur Brooke). CHOOSING A CAREER (A. C. Marshall).

COMMERCIAL TRAINING.—XXVI

THE majority of shopkeepers deal exclusively with one main group of wholesalers, and so long as they receive full satisfaction are not disposed to make changes. By following this plan the number of commercial travellers to be seen and accounts to be kept is reduced to the minimum.

The usual plan with commercial travellers is for them to dispatch a day or two in advance a postcard acquainting the retailer of their approaching visit, unless it be that they call at regular weekly or fortnightly intervals. On receipt of this postcard the retailer makes himself conversant with the state of the stock dealt in by this particular traveller, and looks up his stock-book and other records to ascertain how the individual lines of goods have sold. He then prepares roughly a list of the various items he will require, and when the traveller calls can quickly hand him an order for the stock items before proceeding to discuss novelties, bargain lines and other attractions.

Retail Routine

So much for the question of stock and the all-important stock-book. Approaching now the question of the actual routine of selling and the keeping of cash, it is advisable in all small businesses for a cash register or check till of some kind to be brought into use. The cash register actually prints the amount of each transaction, but with the recording tills these amounts have to be quickly pencilled on a roll of paper.

But first of all we must assume that in every till there is always a kind of floating balance of small change. We may call this £1, and on the day the shop is opened this amount in small change is inserted in the till. In addition to this floating sum for change purposes there are many petty disbursements, the money for which is usually taken from the till.

Small payments to railway and parcels vanmen, postage stamps for receipts, string and similar trifles constitute these items; and the assistant taking these amounts from the till should be required to leave a note of them, or else to jot them down on the second column of the till roll usually provided for the purpose.

At the close of the day's trading, therefore, the till should show the cash takings, less the floating sovereign (in silver, of course) for change, and the petty cash disbursements, and the precise amount should tally with the total of the till roll, or the account of the cash register. The loose change to the value of £1 should then be placed back in the till and the balance transferred to the shop safe.

Financial Matters

It is no part of the scope of this series to deal with the technical aspect of a retailer's accounts, for this side of the undertaking is amply covered in the book-keeping lessons. At the same time it may be explained that in the case of a small retailer doing a strictly cash trade he would keep a record of the day's takings in his Cash Book, an account with two sides, recording on the left-hand side his receipts, and on the right-hand side the amounts he pays out.

With credit trading it is necessary to keep a Day Book, in which is recorded every credit transaction as it takes place, the name of the customer, nature and quantity of goods supplied, and the price. The Day Book, as it were, constitutes a rough record of the transaction, made in all the bustle of business.

At the close of the day, however, every item in the Day Book must be transferred to the Ledger. This latter book consists of numbered folios (or loose leaves), together with an index. A separate account is opened with every customer, and a page at least devoted to it.

So far as the payment of the tradesman's own accounts are concerned, the more prompt he can be in making payment the more will it be to his advantage. Wholesale merchants arrange their quotations for supplies upon a fixed basis, less a discount for cash by monthly cheque, or a still greater discount for payment on receipt of the goods. And when one considers the amount of money turned over in a year it will be realised the financial benefit to be derived from paying promptly.

Quite apart from financial gains, a retailer who pays with promptitude may be certain of receiving the closest and best attention from principals and travellers alike. Certainly the greatest profits lie in cases where the retailer pays immediate cash for all his supplies, and where he himself trades with the public only on a basis of prompt cash sales.

Departmental Accounts

Wages to assistants, rent, rates, taxes, lighting and similar expenses of conducting the business are all entered in the cash book as they are paid; and it is an excellent plan for all retailers to keep by them an exact duplicate of their bank passbooks, so that on making payments into their banking accounts or drawing cheques the particular amounts are entered at the time in this book, the private passbook to be compared with the official book at the close of each half year, when the bank accounts are balanced.

And in the case of every small business the keeping of accounts is far more important even than it may appear at first glance. The books themselves should be kept most accurately, but the simpler the system the better. A neat set of books, well and clearly kept, will frequently add considerably to the price of a business that is to be sold, and save many inquiries, whilst for the purpose of satisfying the assessors of income-tax well-kept books are of the utmost value and assistance.

In the case of businesses conducted on a minor departmental system it will be necessary in a way to keep separate sets of books, one for each department. Thus, it is of quite common occurrence for a grocer and provision merchant to keep the two branches of his business on a totally separate footing so that at the end of a given period he may know precisely from which department he has derived the greater profit.

In some instances a separate banking account will be established for each section, and it frequently happens that one branch of a business is placed under the charge of an individual manager, who will depend for the bulk of his income upon a commission to be based on actual profits.

Then, again, the accounts of some businesses are most carefully analysed, not according to departments, but with reference to special lines of goods. A hosier, hatter and outfitter will at the end of a given period be able to prove from his separate account books the precise profits he has made from (1) hats, (2) gloves, (3) hosiery and underwear, (4) ready-made clothes, (5) shirts and collars, and so on; and such knowledge is of the utmost importance, for it proves to the owner of the business precisely the most profitable direction in which to develop.

Practically speaking, the account books of a retailer mirror the whole of his trading, both buying and selling, over a given period. They tell, far more than any bank passbook could do, just how the business stands, and there is every opportunity in all the ramifications of retail trade for the man with individualistic energy to arrange his accounts so clearly and simply that, with a minimum of trouble to himself, they may yet show him a way to prosperity and bring to his notice many pitfalls that without figures might not have been apparent. A. B.

CHOOSING A CAREER.—XXX

Engineering (*continued*).—Having obtained practical and theoretical knowledge of mechanics and mechanical engineering, the student comes to the parting of the ways. Civil engineers, electrical engineers, mechanical engineers and others will all have travelled the same road up to this stage. Some students, those for example who have been in the engineering shops of the locomotive departments of our railway companies and others, may elect to stay on in the precise department, if not the actual works in which they served their apprenticeship. Others may wish to go out into the world seeking positions for themselves; whilst some may wish to set up in practice on their own account.

The civil engineer will, however, find that he has yet much to learn, and will probably take a post in the office of an engineer where he will find opportunities, in addition to classes and other forms of training, for acquiring a knowledge of hydraulics, land

surveying, the resisting powers and stresses of the various materials employed in constructive work, and so on.

Then again, as British civil engineers are frequently employed in the construction of works in other countries, a knowledge of one or more foreign languages is very important. Metallurgy, mineralogy, mines ventilation and also chemistry are important to the civil engineer.

So far as railway and locomotive engineers in the British Dependencies are concerned, they are to a great extent recruited from the students and apprentices of the locomotive workshops of our railway companies at home; and the demand for British engineers throughout the world is undoubtedly very high. The telegraph and cable companies, most of which are British, employ electrical and other engineers; and mining engineers are naturally in request in most of our colonies, so that engineering offers attractions to men who would wish to see the world.

Then, again, there are many branches of municipal employment open to engineers. Tramway directors, gas and water engineers, electric lighting and power specialists, borough engineers—all these come under the heading of municipal employment—and good engineers invariably progress from town to town, for the municipal officer makes frequent changes.

Again, there are the Naval Dockyards, manned in an engineering sense by the Royal Corps of Naval Constructors. Engineers in this branch of the Civil Service commence as boy apprentices at between fourteen and sixteen years of age, and must first pass an educational test prescribed by the *Civil Service Commissioners, Burlington Gardens, London, W.* 1, from whom particulars of forthcoming examinations may be obtained.

Apart from the degrees and diplomas mentioned at the commencement of this lesson, there are various societies to which engineers may belong to their professional advantage.

There is the well-known *Institution of Civil Engineers, Great George Street, Westminster, S.W.* 1, whose members add the initials "M.Inst.C.E." to their names; the *Institute of Mechanical Engineers, Storey's Gate, St. James's Park, S.W.* 1; the *Institute of Electrical Engineers;* the *Institute of Sanitary Engineers,* and many others. To become a member or associate of these institutes candidates are called upon to pass prescribed examinations.

A. C. M.

BOOK-KEEPING.—XXIV

In the last lesson we saw how entries relating to shares would appear in the Journal, in the Cash Book and in a preliminary Balance Sheet. It would be noticed that nothing appeared in these books which would indicate how the shares had been disposed of; and, further, it is unusual to require the payment in full of shares at the date of incorporation.

It is necessary, therefore, to notice the books kept by a company for the purpose of recording the subscription of the capital.

Company Accounts

Entries are usually made in the **Application and Allotment Book** and in the **Share Cash Book,** and details are posted to the **Share Register and Ledger.** The totals only are entered in the ordinary account books of the company.

At the foot of pp. 372 and 373 are shown the usual rulings of the **Application and Allotment Book** and of the **Share Register and Ledger.**

In order to illustrate the Journal, Cash Book, Ledger and Balance Sheet entries of share capital, we will consider the following example:—

A limited company, by means of a prospectus, offered to the public 60,000 ordinary shares of £1 each; 40,000 preference shares of £1 issued at a premium of 2s. 6d. per share; and £40,000 debentures in bonds of £100 each at £95 but redeemable in 20 years at £100.

Let us suppose that 5s. was to be paid on application on all shares, 5s. on each ordinary share at allotment, 7s. 6d. (to include premium) on each preference share at allotment, and the balance on all shares in two calls of 5s. each. Debentures payable £25 on application, balance on allotment.

By reference to the Application and Allotment Book and to the Debenture Register, we find that 100,000 ordinary shares were applied for; certain applications were totally rejected, necessitating a return of deposit on 20,000 shares, whilst some subscribers had less shares than they applied for allotted to them, the deposits on these shares (20,000) being carried forward in reduction of amounts payable on shares actually allotted. The preference shares and debentures were just subscribed.

Let us satisfy ourselves on a few points before turning to the books.

i. Debentures are *not* capital but are true liabilities, being merely bonds evidencing loans to a company.

ii. Debentures may be issued at a discount or at a premium; that is, a company may borrow £100 at 5 per cent. discount, thus receiving £95 cash to be paid back eventually as £100. Shares, however, may be issued at a premium but not at a discount. In this case 40,000 preference shares of £1 each at a premium of 2s. 6d. represent 40,000 × £1 2s. 6d. cash = £45,000 cash, but the preference share capital is only £40,000, the £5,000 being profit to the company for which a ledger account is opened. This profit is not usually available for dividend.

iii. Capital appears as a liability in the Balance Sheet just as debentures appear. It is a true liability to shareholders, but does not require to be met in cash, except on a dissolution.

Below are shown the entries as to capital and debentures in the books of the company:—

The second call will be journalised in exactly the same way. Any calls unpaid or paid in advance would be provided for. These items would not appear in the Journal unless shares were forfeited, but they would appear in the Cash Book, Ledger Account and Balance Sheet.

All money received on application and allotment will be recorded in the Cash Book, and the amount paid into the Bank. The Cash Book record is given after the Ledger Accounts on p. 374.

Entries in Application Account and Allotment Account for preference shares follow the same lines, but are not complicated by transfer of application moneys to allotment. The ordinary share capital account is given on p. 374, and the preference share capital account can be modelled on the same lines. The student should complete these accounts and the first and second call accounts on these models.

JOURNAL.

		£	s.	d.	£	s.	d.
Application Account (Ordinary Shares)	*Dr.*	15,000	–	–			
To Ordinary Share Capital Account					15,000	–	–
(5s. per share on 60,000 shares.)							
Application Account (Ordinary Shares)	*Dr.*	5,000	–	–			
To Allotment Account					5,000	–	–
(Transfer of 5s. per share on 20,000 shares over-subscribed on application.)							
Application Account (Preference Shares) ..	*Dr.*	10,000	–	–			
To Preference Share Capital Account					10,000	–	–
(5s. per share on 40,000 shares.)							
Allotment Account (Ordinary Shares)	*Dr.*	15,000	–	–			
To Ordinary Share Capital Account					15,000	–	–
(5s. per share on 60,000 shares.)							
Allotment Account (Preference Shares)	*Dr.*	15,000	–	–			
To Preference Share Capital Account					10,000	–	–
(5s. per share on 40,000 shares.)							
To Preference Share Premium Account					5,000	–	–
(2s. 6d. per share on 40,000 shares.)							
Application Account (Debentures)	*Dr.*	10,000	–	–			
To Debentures					10,000	–	–
(£25 per £100 bond on £40,000.)							
Debenture Discount	*Dr.*	2,000	–	–			
To Debentures					2,000	–	–
(£5 per £100 bond on £40,000.)							
Allotment Account (Debentures)	*Dr.*	28,000	–	–			
To Debentures					28,000	–	–
(£70 per £100 bond on £40,000.)							
First Call Account (Ordinary Shares)	*Dr.*	15,000	–	–			
To Ordinary Share Capital Account					15,000	–	–
(5s. per share on 60,000 shares.)							
First Call Account (Preference Shares)	*Dr.*	10,000	–	–			
To Preference Share Capital Account					10,000	–	–
(5s. per share on 40,000 shares.)							

The cash book balance (p. 374) is cash received and in Bank for payment of 60,000 £1 ordinary shares, 40,000 £1 preference shares issued at 22s. 6d. and £40,000 debentures bonds of £100 at £95.

i.e. £60,000 (ordinary capital) + £40,000 (preference capital) + premium of £5,000 + £38,000 (cash received for debentures) = £143,000.

The effect of calls unpaid would appear in Cash Book, e.g. where calls on 80 shares are unpaid we should have :—

To 2nd Call ordinary shares—

(£15,000 — £20) 14,980, reducing balance to £142,980. Similarly calls paid in advance previous to the final call are accounted for in the Cash Book, and will be an addition to liabilities in any Balance Sheet issued before capital is fully paid. The capital of the company and the debentures would appear on the liability side of the Balance Sheet :—

STATEMENT AS TO CAPITAL AND DEBENTURES IN BALANCE SHEET.

	£	s.	d.	£	s.	d.
LIABILITIES.						
Nominal Capital £100,000.						
Divided into 60,000 Ordinary Shares of £1 each and 40,000 Preference Shares of £1 each.						
Subscribed Capital.						
60,000 fully-paid Ordinary Shares of £1 each ..	60,000	–	–			
Less calls in arrear	20	–	–			
	59,980	–	–			
40,000 fully-paid Preference Shares of £1 each ..	40,000	–	–			
				99,980	–	–
Debentures.						
400 Bonds of £100 each				40,000	–	–
Premium on Preference Shares				5,000	–	–
				£144,980	–	–

REGISTER OF MEMBERS

1. NAME *BEN DAVIS.*

ADDRESS 13 *Argyle St., Newport (Mon).* OCCUPATION OR DESCRIPTION *Cashier.*

Dr. *Dr.*

SHARES ACQUIRED.								CASH				
No. of Allotment or Transfer Deed.	Date of Entry.	Distinctive Numbers (inclusive).		No. of Shares.	Total Value of Shares held.			Cash Payable.				
		From	To		£	s.	d.	Date when Due.	Nature of Payment.	Amount of Payment. £	s.	d.
	19.. Jan. 21	11	20	10	50	–	–	19.. Jan. 1	Applicatn.	10	–	–
								,, 21	Allotment	10	–	–
								Feb. 21	1st Call	15	–	–

APPLICATION AND

Date.	No. of Application.	Name of Applicant.	Address.	Occupation or Description.	No. of Shares Applied for.	Amount Paid on Application. £	s.	d.
19.. Jan. 1	1	Davis, Ben	13 Argyle Street, Newport (Mon.)	Cashier	20	20	–	–

Against the amount shown would be set off assets, namely Cash in Bank, as per Cash Book, £142,980, and discount on debentures £2,000. Total £144,980.

In all Company Balance Sheets the nominal capital is stated and then the subscribed capital, the part of the subscribed capital received by the company being accounted for in the totals.

Definitions of Terms

A Share.—A share, although of a definite value when subscribed, is merely the right to receive that proportion of the capital of a company on its dissolution, as may be determined by the regulations of the company, and in the meantime to receive such share of the profits, if any, of the company as may be sanctioned by the company, e.g. a company may have a capital of £10,000 in 1,000 shares of £10 each. If on realisation the amount available for division is only £5,500, then the holder of every £10 share will receive £5 10s.

Allotment.—A person becomes a shareholder by purchase of shares from another, or by having shares allotted to him. For purposes of procuring subscriptions for shares, it is usual to issue a prospectus. A prospectus is a notice of willingness to receive applications on the terms laid down in the prospectus.

A form of application usually accompanies a prospectus, and this form should be made use of by an applicant. The common form is a request that a certain number or *any smaller* number of shares be allotted to the applicant. An allotment is the acceptance of the offer of the applicant, and is contained in a **letter of allotment.** Any rejected applicant is notified by **letter of regret.**

Calls on Shares.—Generally a certain proportion of the value of a share is paid on application, a further proportion on allotment and other amounts on call: e.g. X takes 100 shares of £1 each. On application he pays half a crown per share, on allotment a further half a crown, the remainder, fifteen shillings per share, being paid when called up.

The articles generally lay down regulations as to calls, the directors making calls in accordance therewith. Each shareholder is a debtor to the company, liable to pay the call when made. Where the articles so provide, the shareholders may pay the amount unpaid on their shares "in advance of calls."

AND SHARE LEDGER.

Cr. *Cr.*

ACCOUNT.					SHARES TRANSFERRED.								
Cash Paid.					Date of Transfer.	No. of Shares Transferred.	No. of Transfer.	Distinctive Numbers (inclusive).		Total Value of Shares Transferred.			Transferee's Folio.
Date of Payment.	Folio.	Amount of Payment.						From	To	£	*s.*	*d.*	
19..		£	*s.*	*d.*	19..								
Jan. 1	1	10	–	–	Feb. 25	5	1	16	20	25	–	–	251
Jan. 23	1	10	–	–									
Feb. 22	1	15	–	–									

ALLOTMENT BOOK.

No. of Shares Allotted.	Distinctive Nos. (inclusive).		No. of Letter of Allotment.	Amount Payable on Allotment.			Share Ledger Folio.	Money Returned by Cheque.			Letter of Regret. No.	
	From	To		£	*s.*	*d.*		£	*s.*	*d.*		
10	11	20	1	–	–	–	1	–	–	–	—	

Shares at a Premium.—Shares may be issued at a premium, and the amount obtained over the nominal value is in the nature of a "capital profit." It is clearly a profit, although it cannot be used as available for dividends but should be placed to reserve; e.g. new shares are issued by a company in which the value of £10 shares is £11. The company would issue any such further shares at £11 in fairness to existing holders.

LEDGER.

Dr. APPLICATION ACCOUNT (ORDINARY SHARES). *Cr.*

	£	s.	d.		£	s.	d.
To Ordinary Share Capital	15,000	–	–	By Cash	25,000	–	–
,, Allotment Account	5,000	–	–				
,, Cash (returned)	5,000	–	–				
	£25,000	–	–		£25,000	–	–

Dr. ALLOTMENT ACCOUNT (ORDINARY SHARES). *Cr.*

	£	s.	d.		£	s.	d.
To Ordinary Share Capital	15,000	–	–	By Application Account	5,000	–	–
				By Cash	10,000	–	–
	£15,000	–	–		£15,000	–	–

Dr. ORDINARY SHARE CAPITAL ACCOUNT. *Cr.*

	£	s.	d.		£	s.	d.
				By Application Account ..	15,000	–	–
				,, Allotment Account	15,000	–	–
				,, First Call	15,000	–	–
				,, Second Call ..	15,000	–	–
					£60,000	–	–

CASH BOOK.

Dr. *Cash.* *Contra.* *Cr.*

	£	s.	d.		£	s.	d.
To Applicatn. Account Ordy. Shares	25,000	–	–	By Application a/c deposits returned to non-allottees ..	5,000	–	–
,, Applicatn. Account Prefer. Shares	10,000	–	–	By Balance c/d ..	143,000	–	–
,, Applicatn. Account Debentures	10,000	–	–				
,, Allotment Account Ordy. Shares	10,000	–	–				
,, Allotment Account Prefer. Shares	15,000	–	–				
,, Allotment Account Debentures	28,000	–	–				
,, 1st Call, Ordinary Shares	15,000	–	–				
,, 1st Call, Preference Shares	10,000	–	–				
,, 2nd Call, Ordinary Shares	15,000	–	–				
,, 2nd Call, Preference Shares	10,000	–	–				
	£148,000	–	–		£148,000	–	–
To Balance b/d ..	£143,000	–	–				

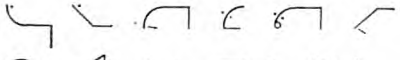
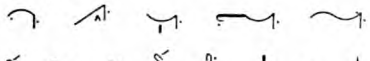
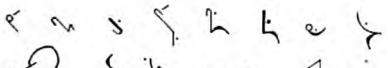
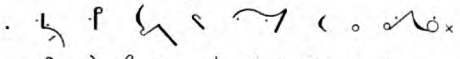
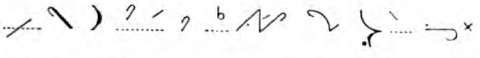
F. H.

SHORTHAND.—XV

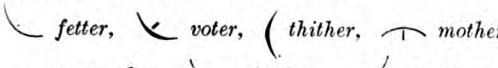
Key to Exercise 52

1. bolt, tilt, jacket, Egypt, kilt, dropped, smart, accurate, snatched, lodged.
2. locket, thicket, vacate, minute, bribed, gagged, slogged.
3. fitted, heated, waded, headed, guided, coated, shouted, mounted.
4. printed, planted, seconded, print, plant, second, doubted, tided, traded, edited.
5. dreamed, chimed, rhymed, descend, resound, piled, bold, bellowed, sold, fared.
6. *We tried to*-get *towards-the building but we* failed.
7. *You were-not told the building-trade was in a very* bad state.
8. *They-did-not tell-it to-the* manager, *and so he-may-not* take *any* steps *to put it* right.

Key to Exercise 53

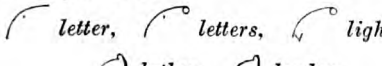
1. 
2. 
3. 
4.
5. 
6. 

Doubling Principle.—Curves written twice their usual length indicate the addition of the syllables, *tr*, *dr*, or *TH r*; thus—



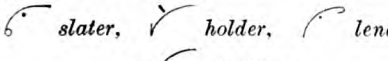
fetter, *voter*, *thither*, *mother*, *another*, *feeder*, *shedder*.

Stroke L.—The stroke *l*, standing alone, or with only a final circle attached, is doubled for *tr* only; thus—



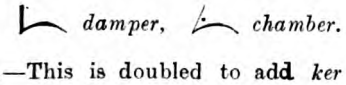
letter, *letters*, *lighters*, *lather*, *leader*.

Under other conditions, the *l* may be doubled for *tr*, *dr*, or *TH r*, as in—



slater, *holder*, *lender*, *moulder*.

MP, MB.—These are doubled to add *-er*, as in—

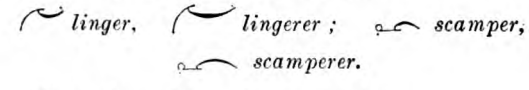


damper, *chamber*.

NG.—This is doubled to add *ker* or *ger*; thus—

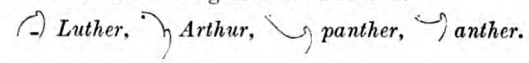
winker, *longer*, *sinker*.

When *mp*, *mb* or *ng* are hooked for *r*, they may be doubled to add *-er*; thus—



linger, *lingerer*; *scamper*, *scamperer*.

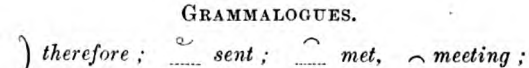
Note the writing of such words as—



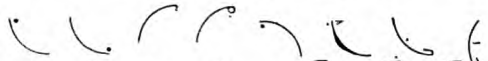
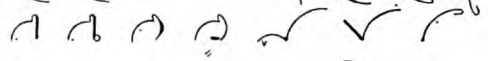
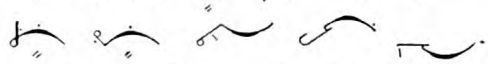
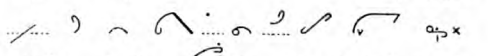
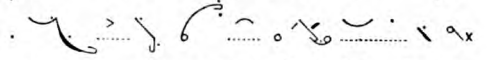
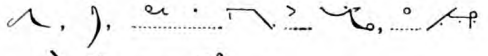
Luther, *Arthur*, *panther*, *anther*.

Exercise 54

GRAMMALOGUES.



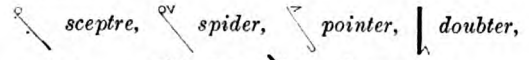
therefore; *sent*; *met*, *meeting*; *third*; *short*; *spirit*; *somewhat*.

1. 
2. 
3. 
4. 
5. 
6. 

Key to Exercise 54

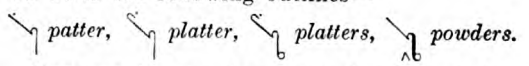
1. father, feeder, litter, litters, ardour, avoider, fender, thunder.
2. ladder, ladders, leather, Luther, milder, builder, lender.
3. December, September, hunger, whimperer, conqueror.
4. *Our third meeting will-be a somewhat short one* like-*the* second.
5. *The* inventor *of-the* patent cylinder *met his* opponents *in a* bad *spirit*.
6. *We-have, therefore, sent-you a* copy *of-the* invoice, *as* requested *by your Mr.* Leader.

Straight Strokes.—Consider the following outlines—



sceptre, *spider*, *pointer*, *doubter*, *mitigator*, *bequeather*.

We notice that straight strokes are doubled for *tr*, *dr*, *TH r*, and that the straight strokes are initially circled, or finally hooked, or have a finally-joined diphthong, or are joined to another stroke. Give careful attention to these conditions and you will understand why we write the following outlines—



patter, *platter*, *platters*, *powders*.

Now we have a few general points before leaving the question of the doubling of strokes.

-Ture.—A few common words ending in *-ture* may be represented by doubling; thus—

adventure, structure, debenture, signature.

Past Tenses.—Verbs which take the doubling principle in the present tense are written by the halving principle for the past tense; thus—

mutter, muttered; temper, tempered; wonder, wondered; pounder, poundered.

A Final Vowel.—It follows from the rules on halving, that a final vowel cannot be preceded by a double-length form; hence we write—

splinter, but *splintery*;
centre, but *sentry*;
pleasanter, but *pleasantry*;
seconder, but *secondary*.

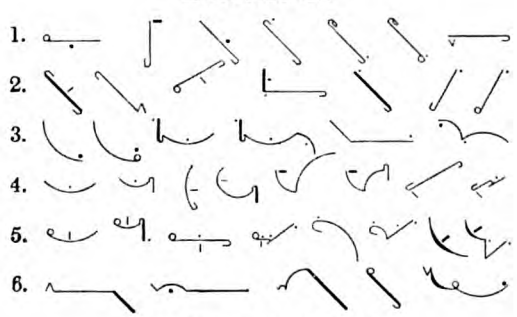
Final S.—A final circle is always read last; thus—

father, fathers; squander, squanders; signature, signatures.

Phrasing.—The words *their, there*, are added by doubling in accordance with the above rules; thus—

if, if there; we shall be there; we know there is; you will be seen there; we take their; can be there.

Exercise 55



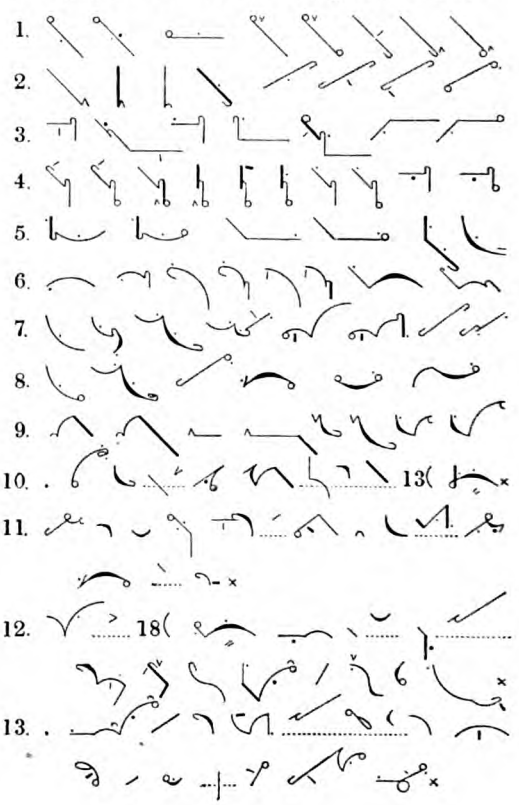
Key to Exercise 55

1. skater, taunter, painter, planter, splinter, splinters, kinder.
2. blunder, prouder, hunter, decanter, banter, chanter, chanters.
3. feature, features, adventure, adventurer, picture, armature.
4. enter, entered, thunder, thundered, falter, faltered, wander, wandered.
5. sunder, sundry, seconder, secondary, flatter, flattery, voter, votary.
6. *how-can-there-be, to-make-their, you-will-be-there, has-been-there, I-have-seen-their.*

Exercise 56

GRAMMALOGUES.

hand, under; yard, word



Exercise 57

1. sceptres, scatter, scatters, prouder, pewter.
2. pointer, tender, gender, squander, suspender.
3. counter, surrender, hunter, rounder.
4. operator, abstracter, objector, educator.
5. timber, chamber, thumper, embers.
6. lumber, lumberer, linger, lingerer.
7. debentures, ventures, signature, features.
8. render, rendered, temper, tempered, simpered.
9. pantry, flattery, sundry, lottery, sultry.
10. *can-be, can-be-their*, form, form-*their*.
11. *We-wish to-have-the* Sunderland *yard* paved *in* September *and* hope *you-will* get-*the* job *in-hand as* soon *as you-can*.
12. *The* pictures were-found *under-the* indicator *by-the* police inspector.
13. Cassell's "Educator" *is-the* last *word in-the* making *of* volumes full *of-the* best *information of-its* kind.

Continued from page 319.

ENGLISH LANGUAGE AND LITERATURE:

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THE NOVEL.—IV

CHARLES Dickens was born at Portsmouth in 1812, the son of a clerk in the Admiralty service who is sketched in *David Copperfield* as Mr. Micawber. Such education as Charles Dickens secured was picked up promiscuously during an unhappy boyhood. His resentment against the poverty that may becloud childhood lasted throughout life.

Charles Dickens, journalist

It shaped the first of his serious books, and the masterpiece of his maturer years. When he was fifteen his father, who had become a parliamentary reporter, found him a position as a junior clerk in a lawyer's office, from whence he escaped into a wider life through Gurney's shorthand. At seventeen he was reporting in the Law Courts; at nineteen entered the Reporters' Gallery of the House of Commons; at three-and-twenty was the most expert shorthand writer on the gallery staff of the "Morning Chronicle," then in the first rank of journalism, and he had already become known to newspaper and magazine editors as the writer of acceptable contributions of the type collected soon after into a volume as *Sketches by Boz.*

Then came an invitation to write the letterpress to an artist's sporting sketches planned for monthly publication, and Dickens, taking control of the enterprise, turned it into *The Pickwick Papers,* and in a few months stepped straight into a popularity which lasted till his death, a third of a century later, in 1870.

His life during this long period of prosperity was filled with hard work and keen enjoyment. He wrote books, edited magazines, travelled, engaged in philanthropic theatricals—for he was an accomplished amateur actor—and read his own works dramatically to thousands in Great Britain and America, until his exertions wore him out, and he died, in his fifty-eighth year, a rich man, and with universal assent was given an honoured grave in Westminster Abbey.

From first to last Dickens was essentially a writer of sketches, his books being made up of a succession of sketches loosely connected. He wandered into "Pickwick" without a plan, and rambled happily through a series of amusing scenes. Afterwards he sought more cohesion by grouping his scenes, with a reformer's motive around the pursuit of some good object, as in *Oliver Twist, Nicholas Nickleby,* and *Bleak House;* or, particularly after he came into close association with Wilkie Collins, he formed a plot which—except in his semi-historical *Tale of Two Cities*—was so far from being essential that it can be forgotten while the characters in the story and the scenes in which they are grouped remain fresh in the memory.

David Copperfield

In his masterpiece, *David Copperfield,* he gained in concentration by using his own life, slightly disguised, as the thread for his scenes; but always we think of Dickens not as the weaver of a narrative that holds us enthralled by its glow of sequent interest, but as a creator of characters who group themselves in a succession of lifelike scenes, each sufficient in itself to sustain our delighted observation.

In short, Dickens acted as showman for a curious variety of men and women who catch the eye chiefly by their eccentricities, and remain in the memory like living persons added to our circle of acquaintances. Many of his characters wander on the stage for a few minutes and then go away without

affecting the progress of the story in the least. They are brought in to give a sense of the copious life around us. His stories served him as occasions for picturing the humour and pathos of the common life open to all observers. This he did with a genial and tender humanity that endears him to the hearts of his readers and makes cold analytical criticism seem an offence.

The great weakness of Dickens to the modern reader is his overstrained sentiment, as in *The Old Curiosity Shop* and *Dombey and Son*. It suited the demands of his age that pathos should be diligently elaborated; but later taste requires a lighter hand.

Then, too, in his exuberance he developed mannerisms that mar his work, as, for example, in the descriptive parts of *Martin Chuzzlewit*, one of his strongest books, where a ship at sea is pictured in writing that is neither prose nor poetry, but a rhetorical chant. Such excesses, however, have a kind of harmony with that almost habitual tendency to exaggeration which gives to so much of Dickens's character-drawing a touch of caricature. It is futile to complain that this national benefactor was not different from what he was—we must accept him with his peccadilloes in a spirit of deep gratitude.

From the portrait by Samuel Lawrence; photo: Emery Walker.

WILLIAM MAKEPEACE THACKERAY (1811-63).

The dates of Dickens's best books leading up to his masterpiece *David Copperfield*, in 1850, were *Pickwick* 1837, *Oliver Twist* 1838, *Nicholas Nickleby* 1839, *Old Curiosity Shop* 1840, and *Martin Chuzzlewit* 1844. After 1850 his work weakened, with the fine exceptions of *A Tale of Two Cities* 1859, and *Great Expectations* 1861.

W. M. Thackeray

William Makepeace Thackeray, who holds the first place among the novelists whose characters are taken from English society, and not from "the masses," was born in Calcutta in 1811, the son of an official of the East India Company. He was educated at Charterhouse School and Cambridge, but left the university after a residence of a year and a half, his objects being to see life abroad and to study art. He varied these pursuits by dabbling in journalism, which became his stay when he had lost his money.

Vanity Fair in Serial Parts

Until the year 1847, when he began the publication of his novel *Vanity Fair* in monthly numbers—the method popularised by Dickens—Thackeray was regarded only as a humorist and clever satirist. His reputation rested on such works as his *Book of Snobs* and *Jeames's Diary*, both written for "Punch." His clever story *Barry Lyndon*, which appeared in "Fraser's Magazine," attracted no special attention.

Vanity Fair, however, took the world of letters by storm; and, later, *Pendennis* (1848), *Esmond* (1852), and *The Newcomes* (1854), with *Vanity Fair* brought their author into the first rank of novelists, a position amply confirmed by the critical verdict of later generations. *The Virginians*, an inferior sequel to *Esmond*, was issued in 1858-9.

In the fifties Thackeray became widely known personally through brilliant lectures on "English Humorists of the Eighteenth Century"—the century with which he was specially familiar—and "The Four Georges."

After 1860 his writings appeared chiefly in the "Cornhill Magazine," which he edited, but he did not again reach the standard of *Vanity Fair*, *Esmond*, and *The Newcomes*. He died suddenly at the end of 1863, when he was on the full tide of success.

The novels which show most favourably Thackeray's great skill as a writer are his eighteenth century story *Esmond* and *Vanity Fair*, written around the character of the adventuress Becky Sharpe. *Pendennis* discloses, in the unheroic hero's career, a certain amount of parallelism with Thackeray's own life. *The Newcomes* is on the whole flattering, but includes some of the author's best writing, and a noble character-portrait in Colonel Newcome.

Signs of a close study of Fielding may

be seen clearly in Thackeray's handling of a story, but his style was his own, and in his happiest moments was extraordinarily vivid and varied, producing more effects in few words, and passing swiftly at will from cynicism to tenderness, from humour to pathos.

Nearly all his characters were chosen from his heart on his sleeve, and so guarded himself by slipping into cynicism. A large-hearted man, and a pellucid writer, Thackeray was greater than he appeared in his somewhat self-conscious works. His pictures of certain grades of English life in the eighteenth century and the first half of the nineteenth century will long retain an historical value,

From the painting by E. M. Ward, R.A.

CHARLES DICKENS (1812–70) IN HIS STUDY

in Tavistock Square, London. The son of an Admiralty clerk, Dickens began his career in a lawyer's office. Two years later he became a Parliamentary reporter and worked for some years as a journalist before he climbed to fame and prosperity as a novelist.

the upper middle-class, or from the social aristocracy, with the hangers-on who haunt the outskirts of somewhat pretentious society. He sketched a rogue with relish, without losing sight of the humanity which the rogue retained.

His heroes, like those of Dickens, tended to insipidity. His most distinctive characters, whether men or women, are drawn with great subtlety, and live without any resort to exaggeration or caricature.

It was a weakness that, though sentimental and sympathetic, he feared to wear and through his easy mastery of English prose his writing provides a useful model for students, or would-be writers. It shows the extraordinary flexibility of which the language is capable in the hands of a master. Without resorting to the overweighted periods of a Carlyle or a Meredith, Thackeray achieves a wealth of colour, lucidity, and often distinction in style. He shares with Dickens a gift of narration, the power of "yarning," which contemporary writers of serious fiction do not possess in such a marked degree. J. D.

PHILOSOPHY.—VII

SINCE mentality (feeling, thought, etc.) is, to the lay mind, a property confined to living things, it is incumbent upon us to essay a distinction between living and not-living, and then if we find that no such distinction is tenable, the way will be open to consider the evidence, if any, for the parallelist view that all matter is the seat of mind.

On the other hand, if there is a real difference between the two, and if the common-sense view that mind is only associated with living matter is true, it will follow that the view that mentality is co-existent with materiality is untrue.

What Is Life?

From what has already been said about the absence of well-defined boundaries in nature (Lesson I), we should expect to find that the two classes—living and not-living—merge into one another by imperceptible or scarcely perceptible gradations. The living and the not-living appear to form the two extremities of a continuous finite series. It is difficult at any one point in the life series to affirm that this is living and that is not; differentiation is clear, however, when long intervals are taken into account.

This circumstance has been advanced by the followers of hylozoism as evidence in favour of their contention that all matter is living; but it would be equally logical—or illogical—to use it to substantiate the claim that all matter is lifeless.

The very chemical elements, they say, which compose matter that is indisputably living, viz., oxygen, nitrogen, carbon, hydrogen, sulphur and phosphorus, are also the fundamental constituents of many substances which are undeniably lifeless. What is more natural than to suppose that life is inherent in these ultimate units, and that therefore any substances which are produced by their combination also possess some kind of life.

In reply one may say that it trespasses against the canon already formulated: we can only argue on life *as we know it;* of all other conceptually possible kinds of life which are not found in experience we can affirm nothing. As regards the question of "living" elements, the evidence refutes rather than supports the contentions, for every student of chemistry knows that the properties of compounds are totally unlike the properties of their constituent elements.

Therefore if we would attempt to establish a difference between living and not-living we must look elsewhere than in the cloudy borderland between the two.

Attempts to define life have been no less unsuccessful than those to define matter or mind. Definitions such as "life is the state of living," "life is the sum total of the phenomena common to all living beings," "life is displayed only by living bodies, by all living bodies, and is what distinguishes living bodies from bodies that are not alive," leave us exactly "as we were"; they merely define a thing in terms of itself.

Herbert Spencer's formula, "life is the continuous adjustment of internal to external relations" is more satisfactory, although it is by no means sufficient.

As applied to living beings it only states part of the truth, and it fails to establish a criterion between living and not-living since the phenomena of irritability, implied in the definition, are also observed among forms of matter which are held to be lifeless.

Characteristics of Life

We shall therefore have to pass on without attempting to frame an all-comprehensive definition of the "great enigma." Ours must be the more modest task of describing it, in the hope that we may arrive at a more precise conception of it than that which is entertained by the lay mind.

Even in the earliest times the power of movement was held to be a characteristic of life; primitive man showed a preference for moving objects, sun, moon, winds, rivers, etc., as the special seats for in-dwelling spirits, but in modern times the property of spontaneous movement has been more especially identified with life.

It is indeed an indication of life but not a distinguishing feature because recognised "dead" matter such as potassium, sodium, show great power of spontaneous motion when put on water. These and other similar phenomena are conditioned by changes in the surface tension of the liquids.

Oil drops and mercury exhibit movements indistinguishable from the movements of certain low organisms, e.g. amœbæ.

Irritability is a kind of motion which may be defined as movement in response to an external stimulus, as when a horse twitches his skin to dislodge a fly, or when a moth flies to a light.

But no one can deny that an explosive very readily responds to an external stimulus, or that the hammer of an electric-bell moves when placed in the suitable electric field.

Herbert Spencer's definition, however, expressly states that vital irritability is a continuous process; so long as the organism exists it reacts with its environment; but it is not difficult to adduce examples from chemistry in which "gross" matter continuously changes in response to changes in its environment.

It thus appears that irritability, either discontinuous or continuous, cannot by itself be taken as a criterion of life. Again, that very slow form of movement called growth might be considered as a property characteristic of living matter.

One often compares living matter and inorganic crystals; both grow by the intake of nourishment from outside and there is usually a limit to the extent of growth in each—but the comparison is superficial, since the physical and the chemical composition of the two are very different.

Leduc has shown how the phenomena of growth can be reproduced in the laboratory by the use of inorganic colloids in a suitable solution, and he has even successfully imitated the growth and division of a cell by similar means.

Structure of Living Matter

The structure of living matter is cellular, consisting of one or more (up to millions of) individual cells which exhibit similar phenomena to those of the whole organism. In lower types of organisms there is sometimes only one cell, in others—multicellular organisms—the cells are all alike and exercise the same functions, but in the higher organisms there is not only a multiplicity of cells but a variety of function.

Again, the essential condition of the existence of a single cell is that it must be surrounded by a medium of such composition that the cell can use it as nourishment.

The main condition of the continued existence of a multicellular organism is that its parts should be so co-ordinated that they work together for the good of the whole, and this co-ordination is effected by the nervous system which regulates the movements of the body through the muscles and the secretion of certain materials by the glands.

The structure of matter regarded as non-living bears no similarity to that just described, but it is possible, as Leduc has shown, to make almost perfect imitations of cells out of purely inorganic materials, which perform similar functions.

There is a great difference, however, in the chemical composition of the two, and in this fact we are able to discern a far better criterion between life and non-life.

Living cellular matter, or protoplasm, is essentially a colloidal solution of nitrogenous matter, called albumin or proteid, with which certain inorganic substances are associated. This solution is enclosed by a film, probably also of colloidal nature, which acts the part of an osmotic membrane in allowing the diffusion of matter between cell and environment to take place, and other similar films exist within the protoplasm.

The changes which take place within the cell and those which occur as a result of osmosis, are also conditioned by the presence of unorganised ferments, called enzymes, which are formed within the protoplasm

Osmotic Growth

Now the functions of this living matter can be imitated in the laboratory with inorganic materials; in the words of Leduc, "An osmotic growth has an evolutionary existence; it is nourished by osmosis and intussusception; it exercises a selective choice on the substances offered to it; it changes the chemical composition of its nutriment before assimilating it. Like a living thing it ejects into its environment the waste products of its function. Moreover, it grows and develops structures like those of living organisms, and it is sensitive to many exterior changes, which influence its form and development."

There is a radical difference in the chemical composition of the two organised objects.

Organised living matter always contains carbon, hydrogen, oxygen, nitrogen and phosphorus, with which is associated a large quantity of water—nearly 70 per cent.—and certain inorganic salts such as sodium chloride, calcium, iron, potassium and magnesium salts.

The osmotic growths of Leduc contain some of the same chemical elements, but they are in a totally different state of combination; they contain no proteins, which are the chief and invariable constituents of protoplasm. As to the possibility that living cellular matter may ever be made by man, we may say that it is not impossible, for many proteins have already been prepared in the laboratory, but there is still a huge chasm between the most complete proteins synthetised in the laboratory and the simplest active cellular matter found in Nature. So far, there is no trace of the existence of substances intermediate between them. E. H. T.

ENGLAND
During the CIVIL WAR
1642-1649.
English Miles
0 10 20 30 40 50 60
SCOTLAND
Glasgow
Edinburgh
Dunbar
Berwick
Tweed
Solway Firth
NORTHUMBERLAND
Newburn
Tyne
Newcastle
Carlisle
CUMBERLAND
Durham
DURHAM
Tees
WESTMORLAND
Pierce Br.
Bolton Cas.
Scarborough
Scalby
I. of Man
IRISH SEA
Morcambe B.
Lancaster
Knaresborough
YORK
Derwent
Eridlington
Bolton Abbey
Skipton
Marston Moor
York
Preston
Todcaster
Leeds
Beverley
Hull
R. Ribble
Adwalton Moor
Selby
Bradford
Wakefield
Pontefract
Latham Ho.
LANCASHIRE
Wigan
Bolton
Manchester
R. Humber
Liverpool
Gainsborough
R. Dee
Warrington
Winnington Br.
LINCOLN
Lincoln
Hornecastle
ANGLESEY
Bangor
CHESHIRE
Chester
DERBY
Winceby
Carnarvon B.
CARNARVON
DENBIGH
FLINT
Rowton Heath
Beeston Cas.
Nantwich
NOTTINGHAM
Trent
Newark
Boston
The Wash
Nottingham
Grantham
MERIONETH
Harlech
Oswestry
Hopton Heath
Derby
Wem
Stafford
Ashby
Crowland
NORFOLK
Norwich
Yarmouth
Shrewsbury
STAFFORD
Leicester
RUTLAND
Stamford
Nen
MONTGOMER
SHROPSHIRE
Lichfield
Tamworth
LEICESTER
CARDIGAN BAY
Montgomery
Aberystwith
Bridgenorth
Severn
Birmingham
Coventry
Welland
Naseby
HUNTING
DON
Hopton Cas.
Ludlow
WARWICK
NORTHAMPTON
Huntingdon
Cambridge
Bury St. Edmunds
RADNOR
WORCESTER
Warwick
Holmby Ho.
SUFFOLK
CARDIGAN
Cardigan
Teifi
Worcester
Northampton
Towcester
Powick Br.
Edge Hills
BRECKNOCK
Wye
HEREFORD
Hereford
BEDFORD
Bedford
Goodrich Cas.
Banbury
Newport Pagnall
Harwich
Colchester
PEMBROKE
Haverford West
CARMARTHEN
Stow
Brill
Aylesbury
Ragland Cas.
GLOUCESTER
Gloucester
OXFORD
Oxford
HERTFORD
ESSEX
Chelmsford
Pembroke
GLAMORGAN
Cirencester
Chepstow
Chalgrove
St. Fagans
Malmesbury
Marlborough
Bristol
MIDDLESEX
Uxbridge
R. Thames
Bristol Channel
R. Severn
Lansdown
Bath
Devizes
Newbury
WILTS
Old Basing
Basingstoke
SURREY
Greenwich
Rochester
Canterbury
Maidstone
KENT
Walmer
Dover
Barnstaple
SOMERSET
Langport
Wardour Cas.
HANTS
Farnham
Alton
Alresford
Winchester
Torrington
Taunton
Southampton
SUSSEX
Stratton
DEVON
DORSET
Arundel
Chichester
Launceston
Exeter
Dorchester
Wareham
Poole
Portsmouth
Newport
Carisbrook Cas.
I. of Wight
Strait of Dover
Tavistock
Brentor
Bridock Down
Plymouth
Lostwithiel
Truro
Fowey
Lyme Regis
Weymouth
Corfe Cas.
CORNWALL
Falmouth
Pendennis Cas
ENGLISH CHANNEL
FRANCE

Continued from page 328.

HISTORY:

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BRITAIN'S STORY.—XIV

[*The introductory chapter to* LORD MACAULAY'S "*History of England*" *has been adopted in this work to explain the development of the British race prior to* 1660. *But as Lord Macaulay's work was intended merely as a sketch, explanatory passages (printed in closer type) have been interpolated in order to meet the requirements of the student.*]

ON January 10, 1642, Charles I. quitted London, never to return till the day of a terrible and memorable reckoning had arrived. A negotiation began which occupied many months. Accusations and recriminations passed backward and forward between the contending parties. All accommodation had become impossible. The sure punishment which waits on habitual perfidy had at length overtaken the King.

Civil War

It was to no purpose that he now pawned his royal word, and invoked heaven to witness the sincerity of his professions. The distrust with which his adversaries regarded him was not to be removed by oaths or treaties. They were convinced that they could be safe only when he was utterly helpless. Their demand, therefore, was, that he should surrender, not only those prerogatives which he had usurped in violation of ancient laws and of his own recent promises, but also other prerogatives which the English Kings had always possessed, and continue to possess at the present day. No minister must be appointed, no peer created, without the consent of the Houses. Above all, the sovereign must resign that supreme military authority which, from time immemorial, had appertained to the regal office.

That Charles would comply with such demands while he had any means of resistance, was not to be expected. Yet it will be difficult to show that the Houses could safely have exacted less.

They were truly in a most embarrassing position. The great majority of the nation was firmly attached to hereditary monarchy. Those who held republican opinions were as yet few, and did not venture to speak out. It was therefore impossible to abolish kingly government. Yet it was plain that no confidence could be placed in the King.

When a country is in the situation in which England then was, when the kingly office is regarded with love and veneration, but the person who fills that office is hated and distrusted, it should seem that the course which ought to be taken is obvious. The dignity of the office should be preserved; the person should be discarded. Thus our ancestors acted in 1399 and in 1689. Had there been, in 1642, any man occupying a position similar to that which Henry of Lancaster occupied at the time of the deposition of Richard II., and which William of Orange occupied at the time of the deposition of James II., it is probable that the Houses would have changed the dynasty, and would have made no formal change in the constitution.

The Revolution Compromise

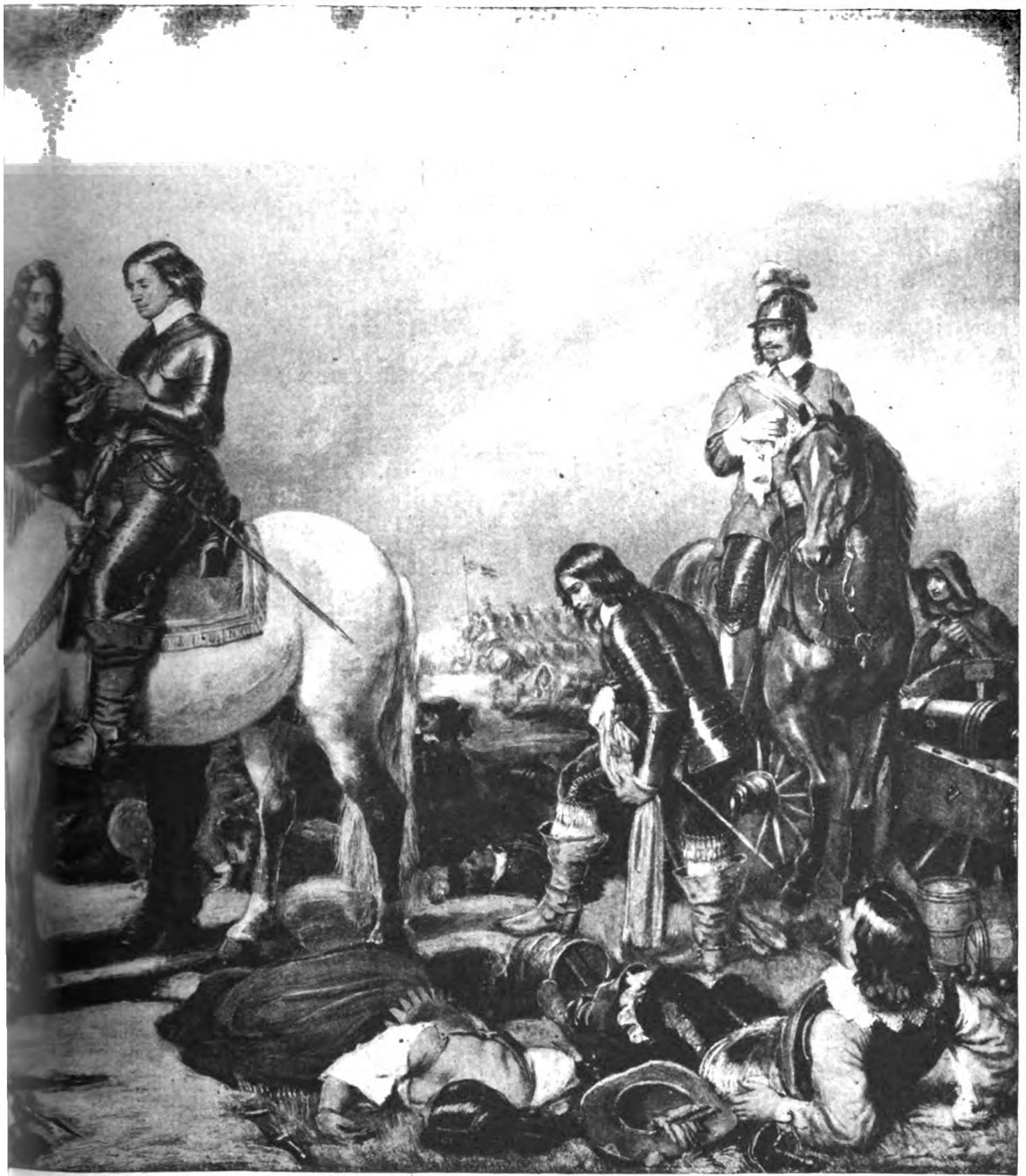
The new King, called to the throne by their choice, and dependent on their support, would have been under the necessity of governing in conformity with their wishes and opinions. But there was no prince of the blood royal in the parliamentary party; and, though that party contained many men of high rank and many men of eminent ability, there was none who towered so conspicuously above the rest that he could be proposed as a candidate for the crown.

As there was to be a King, and as no new King could be found, it was necessary to leave the regal title to Charles. Only one course, therefore, was left; and that was to disjoin the regal title from the regal prerogatives.

The change which the Houses proposed to

OLIVER CROMWELL AFTER THE

when the king lost 1,000 slain, 5,000 prisoners, and nearly all his officers and all his artillery and arms. early in 1645; and, while dooming the king's cause to failure, it proved the



From the picture by Charles Landseer in the Berlin Museum.

BATTLE OF NASEBY, JUNE 14TH, 1645,

The battle was a signal and decisive victory for the Army of the New Model which first took the field turning point in the struggle between the Independents and the Presbyterians.

make in our institutions, though it seems exorbitant, when distinctly set forth and digested into articles of capitulation, really amounts to little more than the change which, in the next generation, was effected by the Revolution.

It is true that, at the Revolution, the sovereign was not deprived by law of the power of naming his ministers: but it is equally true that, since the Revolution, no minister has been able to retain office six months in opposition to the sense of the House of Commons. It is true that the sovereign still possesses the power of creating peers, and the more important power of the sword: but it is equally true that in the exercise of these powers the sovereign has, ever since the Revolution, been guided by advisers who possess the confidence of the representatives of the nation.

Roundheads and—

In fact, the leaders of the Roundhead party in 1642, and the statesmen who, about half a century later, effected the Revolution, had exactly the same object in view. That object was to terminate the contest between the Crown and the Parliament, by giving to the Parliament a supreme control over the executive administration. The statesmen of the Revolution effected this indirectly by changing the dynasty. The Roundheads of 1642, being unable to change the dynasty, were compelled to take a direct course towards their end.

We cannot, however, wonder that the demands of the opposition, importing as they did a complete and formal transfer to the Parliament of powers which had always belonged to the Crown, should have shocked that great party of which the characteristics are respect for constitutional authority and dread of violent innovation.

That party had recently been in hopes of obtaining by peaceable means the ascendency in the House of Commons; but every such hope had been blighted. The duplicity of Charles had made his old enemies irreconcilable, had driven back into the ranks of the disaffected a crowd of moderate men who were in the very act of coming over to his side, and had so cruelly mortified his best friends that they had for a time stood aloof in silent shame and resentment.

Now, however, the constitutional Royalists were forced to make their choice between two dangers; and they thought it their duty rather to rally round a prince whose past conduct they condemned, and whose word inspired them with little confidence, than to suffer the regal office to be degraded, and the polity of the realm to be entirely remodelled. With such feelings, many men whose virtues and abilities would have done honour to any cause, ranged themselves on the Royalist side.

In August, 1642, the sword was at length drawn; and soon, in almost every shire of the kingdom, two hostile factions appeared in arms against each other.

It is not easy to say which of the contending parties was at first the more formidable. The Houses commanded London and the counties round London, the fleet, the navigation of the Thames, and most of the large towns and seaports. They had at their disposal almost all the military stores of the kingdom, and were able to raise duties, both on goods imported from foreign countries, and on some important products of domestic industry.

The King was ill provided with artillery and ammunition. The taxes which he laid on the rural districts occupied by his troops produced, it is probable, a sum far less than that which the Parliament drew from the city of London alone. He relied, indeed, chiefly, for pecuniary aid, on the munificence of his opulent adherents.

—Royalists

Charles, however, had one advantage. The parliamentary army was made up of hirelings whom want and idleness had induced to enlist. Hampden's regiment was regarded as one of the best; and even Hampden's regiment was described by Cromwell as a mere rabble of tapsters and serving men out of place. The royal army, on the other hand, consisted in great part of gentlemen, high spirited, ardent, accustomed to consider dishonour as more terrible than death, accustomed to fencing, to the use of fire-arms, to bold riding, and to manly and perilous sport, which has been well called the image of war.

Such gentlemen, mounted on their favourite horses, and commanding little bands, composed of their younger brothers, grooms, gamekeepers, and huntsmen, were, from the very first day on which they took the field, qualified to play their part with credit in a skirmish. The steadiness, the prompt obedience, the mechanical precision of movement, which are characteristic of the regular soldier, these gallant volunteers never attained. But they were at first opposed to enemies as undisciplined as themselves, and far less active, athletic, and daring. For a time, therefore, the Cavaliers were successful in almost every encounter.

The Houses had also been unfortunate in the choice of a general. The rank and wealth of the Earl of Essex made him one of the most important members of the parliamentary party. He had borne arms on the Continent with credit, and, when the war began, had as high a military reputation as any man in the country. But it soon appeared that he was unfit for the post of Commander-in-Chief. He had little energy and no originality. The methodical tactics which he had learned in the war of the Palatinate did not save him from the disgrace of being surprised and baffled by such a Captain as Rupert, who could claim no higher fame than that of an enterprising partisan.

Nor were the officers who held the chief commissions under Essex qualified to supply what was wanting in him. For this, indeed, the Houses are scarcely to be blamed. In a country which had not, within the memory of the oldest person living, made war on a great scale by land, generals of tried skill and valour were not to be found. It was necessary, therefore, in the first instance, to trust untried men; and the preference was naturally given to men distinguished either by their station, or by the abilities which they had displayed in Parliament.

In scarcely a single instance, however, was the selection fortunate. Neither the grandees nor the orators proved good soldiers. The Earl of Stamford, one of the greatest nobles of England, was routed by the Royalists at Stratton. Nathaniel Fiennes, inferior to none of his contemporaries in talents for civil business, disgraced himself by the pusillanimous surrender of Bristol. Indeed, of all the statesmen who at this juncture accepted high military commands, Hampden alone appears to have carried into the camp the capacity and strength of mind which had made him eminent in politics.

When the war had lasted a year, the advantage was decidedly with the Royalists. They were victorious, both in the western and in the northern counties. They had

From the fresco by C. W. Cope, R.A., in the House of Lords.

THE SETTING OUT OF THE TRAINED BANDS FROM LONDON

to raise the siege of Gloucester which, after a number of initial successes, the Royalists had invested in August, 1643. The city was relieved on September 5.

wrested Bristol, the second city in the kingdom, from the Parliament. They had won several battles, and had not sustained a single serious or ignominious defeat.

Among the Roundheads adversity had begun to produce dissension and discontent. The Parliament was kept in alarm, sometimes by plots, and sometimes by riots. It was thought necessary to fortify London against the royal army, and to hang some disaffected citizens at their own doors. Several of the most distinguished peers who had hitherto remained at Westminster fled to the court at Oxford; nor can it be doubted that, if the operations of the Cavaliers had, at this season, been directed by a sagacious and powerful mind, Charles would soon have marched in triumph to Whitehall.

Siege of Gloucester

But the King suffered the auspicious moment to pass away; and it never returned. In August, 1643, he sat down before the city of Gloucester. That city was defended by the inhabitants and by the garrison, with a determination such as had not, since the commencement of the war, been shown by the adherents of the Parliament. The emulation of London was excited. The trainbands of the City volunteered to march wherever their services might be required. A great force was speedily collected, and began to move westward. The siege of Gloucester was raised: the Royalists in every part of the kingdom were disheartened: the spirit of the parliamentary party revived: and the apostate Lords, who had lately fled from Westminster to Oxford, hastened back from Oxford to Westminster.

And now a new and alarming class of symptoms began to appear in the distempered body politic. There had been, from the first, in the parliamentary party, some men whose minds were set on objects from which the majority of that party would have shrunk with horror. These men were, in religion, Independents. They conceived that every Christian congregation had, under Christ, supreme jurisdiction in things spiritual; that appeals to provincial and national synods were scarcely less unscriptural than appeals to the Court of Arches, or to the Vatican; and that Popery, Prelacy, and Presbyterianism were merely three forms of one great apostasy.

In politics, the Independents were, to use the phrase of their time, root and branch men, or, to use the kindred phrase of our own time, radicals. Not content with limiting the power of the monarch, they were desirous to erect a commonwealth on the ruins of the old English polity.

At first they had been inconsiderable, both in numbers and in weight; but before the war had lasted two years they became, not indeed the largest, but the most powerful faction in the country.

Some of the old parliamentary leaders had been removed by death; and others had forfeited the public confidence. Pym had been borne, with princely honours, to a grave among the Plantagenets. Hampden had fallen, as became him, while vainly endeavouring, by his heroic example, to inspire his followers with courage to face the fiery cavalry of Rupert. Bedford had been untrue to the cause. Northumberland was known to be lukewarm. Essex and his lieutenants had shown little vigour and ability in the conduct of military operations. At such a conjuncture it was that the Independent party, ardent, resolute, and uncompromising, began to raise its head, both in the camp and in the House of Commons.

Oliver Cromwell

The soul of that party was Oliver Cromwell.

Bred to peaceful occupations, he had, at more than forty years of age, accepted a commission in the parliamentary army. No sooner had he become a soldier than he discerned, with the keen glance of genius, what Essex, and men like Essex, with all their experience, were unable to perceive. He saw precisely where the strength of the Royalists lay, and by what means alone that strength could be overpowered. He saw that it was necessary to reconstruct the army of the Parliament. He saw also that there were abundant and excellent materials for the purpose, materials less showy, indeed, but more solid, than those of which the gallant squadrons of the King were composed.

It was necessary to look for recruits who were not mere mercenaries, for recruits of decent station and grave character, fearing God and zealous for public liberty. With such men he filled his own regiment, and, while he subjected them to a discipline more rigid than had ever before been known in England, he administered to their intellectual and moral nature stimulants of fearful potency.

The events of the year 1644 fully proved the superiority of his abilities. In the south, where Essex held the command, the parliamentary forces underwent a succession of

shameful disasters; but in the north the victory of Marston Moor fully compensated for all that had been lost elsewhere.

That victory was not a more serious blow to the Royalists than to the party which had hitherto been dominant at Westminster; for it was notorious that the day, disgracefully lost by the Presbyterians, had been retrieved by the energy of Cromwell, and by the steady valour of the warriors whom he had trained.

These events produced the Selfdenying Ordinance and the new model of the army. Under decorous pretexts, and with every mark of respect, Essex and most of those who had held high posts under him were removed; and the conduct of the war was entrusted to very different hands. Fairfax, a brave soldier, but of mean understanding and irresolute temper, was the nominal Lord General of the forces; but Cromwell was their real head.

Battle of Naseby

Cromwell made haste to organise the whole army on the same principles on which he had organised his own regiment. As soon as this process was complete, the event of the war was decided. The Cavaliers had now to encounter natural courage equal to their own, enthusiasm stronger than their own, and discipline such as was utterly wanting to them. It soon became a proverb that the soldiers of Fairfax and Cromwell were men of a different breed from the soldiers of Essex.

At Naseby took place the first great encounter between the Royalists and the remodelled army of the Houses. The victory of the Roundheads was complete and decisive. It was followed by other triumphs in rapid succession. In a few months the authority of the Parliament was fully established over the whole kingdom. Charles fled to the Scots, and was by them, in a manner which did not much exalt their national character, delivered up to his English subjects.

While the event of the war was still doubtful, the Houses had put the Primate to death, had interdicted, within the sphere of their authority, the use of the Liturgy, and had required all men to subscribe that renowned instrument known by the name of the Solemn League and Covenant.

Covenanting work, as it was called, went on fast. Hundreds of thousands affixed their names to the rolls, and, with hands lifted up towards heaven, swore to endeavour, without respect of persons, the extirpation of Popery and Prelacy, heresy and schism, and to bring to public trial and condign punishment all who should hinder the reformation of religion.

When the struggle was over, the work of innovation and revenge was pushed on with increased ardour. The ecclesiastical polity of the kingdom was remodelled. Most of the old clergy were ejected from their benefices. Fines, often of ruinous amount, were laid on the Royalists, already impoverished by large aids furnished to the King. Many estates were confiscated. Many proscribed Cavaliers found it expedient to purchase, at an enormous cost, the protection of eminent members of the victorious party. Large domains, belonging to the crown, to the bishops, and to the chapters, were seized, and either granted away or put up to auction.

In consequence of the e spoliations, a great part of the soil of England was at once offered for sale. As money was scarce, as the market was glutted, as the title was insecure, and as the awe inspired by powerful bidders prevented free competition, the prices were often merely nominal. Thus many old and honourable families disappeared and were heard of no more; and many new men rose rapidly to affluence.

Government by the Sword

But, while the Houses were employing their authority thus, it suddenly passed out of their hands. It had been obtained by calling into existence a power which could not be controlled. In the summer of 1647, about twelve months after the last fortress of the Cavaliers had submitted to the Parliament, the Parliament was compelled to submit to its own soldiers.

Thirteen years followed, during which England was, under various names and forms, really governed by the sword. Never before that time, or since that time, was the civil power in our country subjected to military dictation.

The army which now became supreme in the state was an army very different from any that has since been seen among us. The pay of the private soldier was much above the wages earned by the great body of the people; and, if he distinguished himself by intelligence and courage, he might hope to attain high commands.

The ranks were accordingly composed of persons superior in station and education to the multitude. These persons, sober, moral, diligent, and accustomed to reflect, had been induced to take up arms, not by the pressure of want, not by the love of novelty and

license, not by the arts of recruiting officers, but by religious and political zeal, mingled with the desire of distinction and promotion.

And such was the intelligence, the gravity, and the self-command of the warriors whom Cromwell had trained, that in their camp a political organisation and a religious organisation could exist without destroying military organisation. The same men, who, off duty, were noted as demagogues and field preachers, were distinguished by steadiness, by the spirit of order, and by prompt obedience on the field of battle.

Cromwell's Ironsides

In war this strange force was irresistible. The stubborn courage characteristic of the English people was, by the system of Cromwell, at once regulated and stimulated. Other leaders have maintained order as strict. Other leaders have inspired their followers with zeal as ardent. But in his camp alone the most rigid discipline was found in company with the fiercest enthusiasm. His troops moved to victory with the precision of machines, while burning with the fanaticism of Crusaders. From the time when the army was remodelled to the time when it was disbanded, it never found, either in the British Islands or on the Continent, an enemy who could stand its onset.

Austere Morality

But that which chiefly distinguished the army of Cromwell from other armies was the austere morality and the fear of God which pervaded all ranks. It is acknowledged by the most zealous Royalists that, in that singular camp, no oath was heard, no drunkenness or gambling was seen, and that, during the long dominion of the soldiery, the property of the peaceable citizen and the honour of woman were held sacred.

If outrages were committed, they were outrages of a very different kind from those of which a victorious army is generally guilty. No servant girl complained of the rough gallantry of the redcoats. Not an ounce of plate was taken from the shops of the goldsmiths. But a Pelagian sermon, or a window on which the Virgin and Child were painted, produced in the Puritan ranks an excitement which it required the utmost exertions of the officers to quell.

By permission of Mark Frith, Esq., and the Hon. F. F. Freemantle.

Accoutrements of Charles I. and Prince Rupert at Wistow Hall where the king stayed for a day after the Battle of Naseby.

Continued from page 342.

SCIENCES:

Contributors :—ANTHROPOLOGY AND ETHNOLOGY (Sir H. H. Johnston, G.C.M.G., K.C.B.). ASTRONOMY (Arthur R. Hinks, M.A., F.R.S.). BOTANY (E. W. Edmunds, M.A., B.Sc.[Lond.]). CHEMISTRY (E. H. Tripp, Ph.D.). ELECTRICITY AND MAGNETISM (L. M. Parsons, M.Sc., D.I.C., F.G.S.). GEOLOGY AND MINERALOGY (Arthur Holmes, D.Sc.[Lond.], A.R.C.S., D.I.C., F.G.S.). PHYSIOLOGY (Sir Malcolm Morris, K.C.V.O., and D. W. Carmalt-Jones, M.A., M.D.(Oxon.]). SOUND, LIGHT, AND HEAT (E. W. Edmunds, M.A., B.Sc.[Lond.]). ZOOLOGY (E. A. Bryant and Ashley G. Brown, F.Z.S.).

ELECTRICITY AND MAGNETISM.—XVIII

The Split-ring Commutator.—A commutator is a current reverser. The currents induced in the armature of a magneto or dynamo alternate during a rotation, but a suitably constructed current reversing device fixed to the armature axle will counteract the alternating direction of induced currents, thereby causing the current sent through the external circuit to flow in one direction only. The external circuit will consist of the wires, lamp, tramcars or other machines using the current taken from the armature. The simplest form of split-ring commutator consists of two almost semi-circular pieces of metal mounted on the armature axle in such a way that they are insulated from one another and from the iron core of the armature.

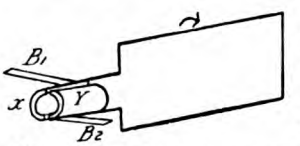


Fig. 62.—Split-ring commutator.

Small gaps are left between the pieces of metal, hence the name of the arrangement.

In the illustration a simple rectangular loop represents the many turns of wire of an actual armature. One end of the loop is connected with the metallic piece X and the other end to Y.

Now as the loop rotates, during one half of a rotation one end and the piece of metal connected with it will be positive, i.e., the current will flow out of the armature from *that* end when the external circuit is complete. The other end will then be negative. The current is sent along the external circuit by means of copper gauze or carbon conductors called *brushes*. These brushes do not move after they have been properly adjusted, hence each of the two pieces of metal X and Y comes in contact with either brush during a complete rotation.

Suppose that the loop begins a rotation from the vertical position and moves in the direction of the arrow, and further suppose that during the first half rotation X is positive. During that half rotation X is in connection with the brush B_1, and the current passes to the external circuit by way of that brush.

During the second half of the rotation the other metallic piece Y is positive since the current in the armature has changed in direction, but as Y is then in contact with the brush B_1, the current still flows from the same brush along the circuit. Hence as long as the armature rotates in that direction, B_1 is always the positive brush, and a continuous current in one direction only is obtained. Although induced currents are of a momentary nature, the speed at which the armature rotates causes such a rapid succession of currents that they are practically equivalent to a continuous current.

In the dynamo diagram (Fig. 63) a circle represents a cross section of the armature, a smaller circle indicates the axle and its commutator, while thick lines show the positive of the brushes and wires connecting them with terminal screws which form a means of connection with the external circuit.

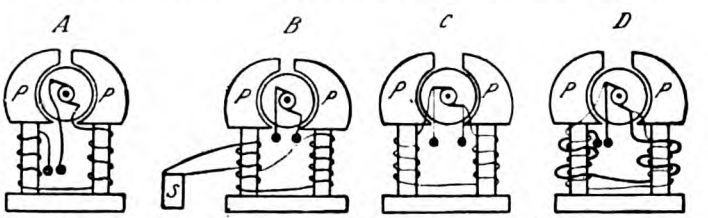


Fig. 63.—Types of Dynamo. In each diagram p p indicate the poles of field magnets. Dynamo A is series-wound; B, excited from separate source; C, is shunt-wound; D, compound-wound.

The Series-wound Dynamo.—Dynamos are similar in principle to the magneto, but are usually much larger, more powerful, and have field magnets which are electro-magnets. These machines are classified according to the way in which the wires

are wound on the field magnets. In most cases the whole or part of the current generated in the armature is sent along wires wound around the magnets, though some dynamos have field magnets which are excited by electricity from a separate apparatus, in which case the machine is called a *separately excited dynamo*. The term "excited" is employed to denote the development of magnetism in the field magnets.

In a series-wound dynamo the *whole* of the current obtained from the armature is sent along thick low resistance wires around the field magnets. Such machines are employed mainly for lighting arc-lamps as used in the streets, and sometimes for working electric motors.

The Shunt-Wound Dynamo.—In a shunt-wound machine the external circuit is connected directly with both brushes, so also is the wire circuit wound around the field magnets, consequently the latter must be connected as a shunt (*see* Vol. IV., pp. 13, 14) of the external circuit. The current obtained from the armature has two paths to traverse, and the proportion of the current which flows around the field magnets will depend upon its resistance compared with that of the external circuit. The shunt consists of thin wire of high resistance, otherwise the external circuit would not be traversed by an adequate proportion of the current. This type of machine is used extensively for many purposes, particularly lighting, *charging accumulators* and electro-plating. Large shunt machines are used for supplying current to mains for general use.

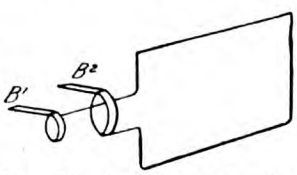


Fig. 64.—Showing the principle of split-rings on the axle of an Alternator's armature. When B^1 is positive, B^2 will be negative.

The Compound-Wound Dynamo.—A dynamo in which the field magnets are excited by both the series and the shunt methods is said to be compound-wound. The illustration gives a general idea of the winding. The shunt wire is wound first, then the series winding on top of it. Machines of this type possess a great advantage on account of the voltage remaining practically constant in spite of the varying amount of work performed in the external circuit, or in other words, they adapt themselves to all loads. The current supplied to mains for electric trams, lighting, etc., is now usually obtained from this class of machine.

It will be understood that all wires used in the construction of armatures and field magnets are thoroughly insulated.

It may be asked how the magnetism in the field magnets of machines not separately excited is first produced in order that a current may be generated in the armature. Even soft iron of which the field magnets are made possesses feeble magnetism when the machine is not working, and this *residual magnetism*, as it is called, is sufficient to generate feeble currents in the armature. These feeble currents flow along the windings around the magnets and improve the magnetic field. The currents are thus increased in value, greater magnetism again results, and so on until the machine is working at its best.

Alternators.—If the alternating currents generated in the armature are passed along the external circuit without their being changed into a one-direction current by means of a commutator, the machine is called an *alternator*. The method of taking such alternating currents out of the armature and along the external circuit is a simple matter.

In place of a split-ring commutator, the axle of the armature bears two slip rings insulated from each other and from the axle. One end of the armature coil is connected to one ring and the other end of the coil to the second ring. One ring comes in contact with only one of the brushes. During half a rotation of the armature the brush B^1 will be positive, but during the second half of the rotation it will be negative. Similarly with the other brush, that is, when B^1 is positive, B^2 will be negative, and vice versa.

The alternating currents thus obtained for use in an external circuit are employed for certain purposes in which a direct or one-way current is not necessary. Some motors and electric trains using such motors are worked by alternating currents.

As we shall see in a later lesson, alternating currents are particularly suitable for lighting street arc-lamps. Very large machines such as a 6,000 horse-power alternator develop a very high E.M.F., many thousands of volts, consequently this type of machine is used for the transmission of electric power from a power station to a distant place where a local supply is required.

Apart from the alternating nature of the currents, alternators are different from dynamos in other respects. The field magnets are not usually excited by current from the armature, but by that supplied from an independent source, such as a small dynamo attached to the shaft of the alternator.

Sometimes the armature is fixed and the field magnets rotate.

A special class of machine called an Inductor Alternator is so constructed that the flow of magnetism through the armature is varied by a rotating iron arrangement while both the armature and the field magnets remain stationary.

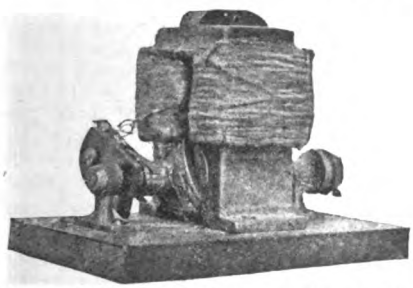
Armatures.—In our preliminary consideration the armature of a machine was represented by a single hoop of wire. It is hardly necessary to say that in actual alternators, dynamos and motors this part of the machine consists of many coils of wire wound on a core in different ways according to the type of armature. The core is composed of many plates or discs of iron of the same size threaded upon the shaft. If a *solid* (i.e. undivided) iron core were used separate induced currents would be generated in the core itself, a condition that would lessen the efficiency of the machine. The use of several plates or discs reduces the formation of such *eddy currents* in the core. The shape of the core gives the name to the type of armature. Thus, drum armatures, in which coils of wire are wound on a cylindrical core, are commonly used.

Other kinds are ring armatures and disc arma-

tures, in which the core takes the form of a ring or disc respectively. All windings are arranged so that the coils of wire cut the magnetic field at right angles to the direction of the lines of force. Usually several independent coils are wound on the core, and these coils are connected with separate portions of the split-ring commutator, which then consists of a metallic ring divided into many parts.

Multi-polar Dynamos.—Many machines have more than one pair of field magnets and are known as multi-polar machines. The number of poles varies in different machines, but the number of north poles is equal to that of the south poles, and these are placed at regular intervals, first a north and then a south, round the place in which the armature rotates. The advantage of such dynamos is that a fairly high voltage can be produced with the armature rotating at a slow speed.

The Electric Motor.—The essential parts of an electric motor are the same as those of a dynamo



A small Electric Motor such as the above can easily be made at home.

—armature, field magnets, brushes, etc. In a dynamo you rotate the armature by means of mechanical power, and obtain a current, whereas in a motor a current from a dynamo or other source is sent into the armature and it rotates, the cause being the magnetic forces of attraction and repulsion developed around the armature.

Dynamos are machines for converting mechanical energy into electrical energy, but motors perform just the reverse transformation.

The construction of a direct current dynamo, i.e. one with a split-ring commutator, is such that the machine will act as a motor if a current is sent through the armature by way of the brushes. But there will be a tendency for the machine to perform its usual functions as a dynamo, since its armature is rotating in a magnetic field. Here we have another case of a *back E.M.F.* opposing that of the dynamo which is supplying the current necessary for working the other machine as a motor. This is true of electric motors in general, hence the voltage of the generating dynamo must be greater than that of the back E.M.F. produced in the motor armature, otherwise there would be no rotation. The difference between the voltage of the generating machine and that of the back E.M.F. is the actual voltage available for causing the armature to rotate.

As in the case of dynamos, electric motors may be series wound, shunt wound, and compound wound, or their field magnets may be separately excited. L. M. P.

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BOTANY.—XII

33. **Stem-Modifications.**—THE rhizome, bulb, etc., discussed in our last lesson are modifications of the stem which serve the purpose of vegetative reproduction. That purpose is also served by various other modifications.

In the Strawberry, towards the end of the season, special branches arise in the axils of the radical leaves and grow very rapidly in a creeping manner. When the tip strikes the ground, its terminal bud at once begins to develop, producing adventitious roots and new aerial shoots, and continuing its rapid growth sympodially from one of its lateral buds. Such a branch is called a *runner* or *stolon*, and if it be cut when the new shoots are well formed, we have two plants instead of one. A short stolon, such as we have in House-Leeks, is usually spoken of as an *offset*. The *suckers* of the Rose, Apple, etc., are similar to runners in their habit, except that they arise underground; that they are not roots is evident from the presence of scale leaves even on the underground portion.

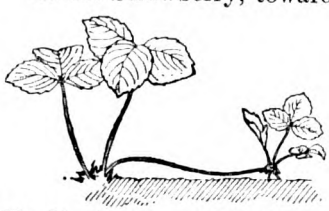


Fig. 71.—Runners of Strawberry.

Fig. 72.—Offset of House-leek.

In the Brambles some of the ordinary branches "scramble" about the ground; at their swollen tips, adventitious roots arise in large numbers, and new shoots also arise from the axils of the scales (*see* p. 395). These shoots ultimately develop into a new Bramble-bush, which may become separate from the parent.

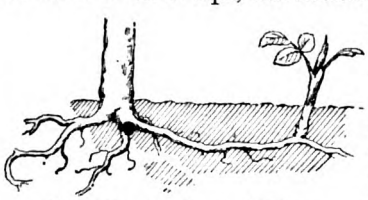


Fig. 73.—Suckers of Rose.

A few British plants and some Lilies bear *bulbils*, small unopened buds, in the axils of some of their leaves. These bulbils are sometimes undeveloped flower-buds, or even branches; they readily fall off, and develop, something like a bulb, into a new plant.

The processes of budding and grafting,

practised by horticulturists, are also akin to vegetative reproduction. The essence of the former is the transfer of a bud from a fine flowering variety which produces no seeds on to the stem of an inferior stock, as in the case of Roses. In grafting, a strip of the valuable plant is inserted wedge-like between the wood and the bark of the native form in such a manner that the vessels of the two may become continuous. Neither grafting nor budding can be done on to a foreign species; e.g. it is impossible to graft Apples on to Oak or Elm because organic continuity cannot be obtained, without which the young shoot cannot be supplied with water.

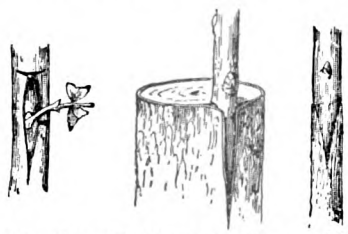


Fig. 74.—To illustrate the principle of Grafting.

Other modifications of the stem serve the function of protection by becoming *thorns* or *spines*. In the Buckthorn the tips of the branches become thorny without other modification; but generally the Thorn is a very reduced branch as in the Hawthorn and Blackthorn. In these cases, especially in the Blackthorn, it is easy to see that the Thorn is a modified branch; it occurs in the leaf-axil, it is woody and has the internal structure of a stem, and finally it bears leaves and flowers on its own account (Fig. 75).

Fig. 75.—Blackthorn, showing leaves and flowers.

In the Gorse both stem-branches and leaves become spiny, and thus are avoided by cattle, to which the plant is otherwise agreeable. The familiar *prickles* of the Rose and Bramble, however, must be carefully distinguished from Thorns; they are adventitious structures, growing anywhere on the stem and on the petioles, and having no internal continuity with the rest of the stem. They are, in fact, but outgrowths of the epidermis or outermost layer of the stem; the numerous hairs seen on the Nettle and many other stems have a similar origin, and generally in one way or another fulfil a similar protective function.

Fig. 76.—Butcher's Broom.

A stem-branch occasionally becomes expanded and green, so as to resemble a leaf, both in appearance and function; such a branch is called a *cladode*. The most familiar case is that of the Butcher's Broom (Fig. 76). That the leaf-like branch is not a leaf is clear from the presence of small flowers upon it and from the scale-leaf immediately beneath it. In the Duckweed, which covers stagnant ponds everywhere, the flat green structure which floats the plant on the water is the whole shoot and is also a cladode (Fig. 77).

Fig. 77.—Duckweed.

34. Climbing Plants.—Some stems are especially adapted to the habit of climbing; but this habit introduces us also to the property of sensitiveness to contact, and thus demands separate treatment. Careful observation has shown that any growing shoot advances upward spirally, not straight. The growing-point describes a continuously enlarging circle, which in most cases, however, is too small to be noticed without some special experimental device. But this behaviour, known as *circumnutation*, is exceptionally strong in climbing shoots, and is a very important aid to them in their climbing habit.

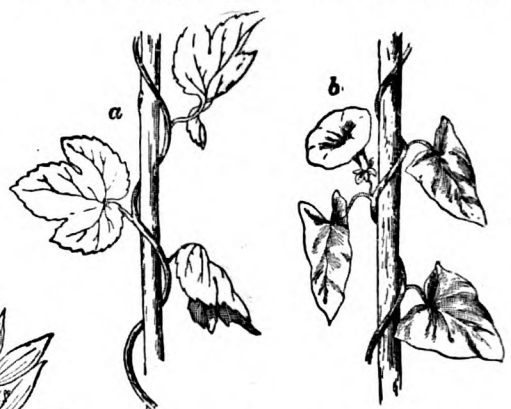


Fig. 78.—*a*, Hop; *b*, Convolvulus.

If a climbing stem, in the course of its wide circumnutations, happens to strike some solid support, like a stick, it at once curves inwards at the point of contact; this curving, aided by the circumnutation, throws the stem again against the support; and the process is repeated until the stem has wound itself spirally around

the support. It is thus clear that the power to climb is associated with two other properties of the climbing plant, namely, growth and sensitiveness to contact.

This sensitiveness itself is also an effect of growth. The result of the touch is a diminished growth on the side touched, which causes the curvature by making that side shorter than the other. The advantage of the climbing habit is obvious; plants which would otherwise be prostrate, and choked by competitors, are lifted up into the light and compete successfully with tall and hardy neighbours.

Plants which have twining stems are the Scarlet Runners, Hop, Honeysuckle, Convolvulus, etc. The direction of twining is constant in the particular plant, but is not the same in all. We may speak of the Hop and the Honeysuckle as left-handed climbers, i.e. they climb from left to right, in front of the support, as viewed by an observer standing beside them. Under this convention, the Convolvulus and Scarlet Runner are right-handed climbers (Fig. 78 *b*).

The most sensitive climbing-organs are the *tendrils* of such plants as the Bryony, Vine, etc. Tendrils are of varied morphological origin. Those of the Vine and the Virginia Creeper are modified branches; those of the Pea are reduced leaflets; and in Smilax it is the stipules that are metamorphosed into tendrils.

The behaviour of tendrils can be well studied in the common White Bryony of our hedgerows (Fig. 80). Here the tendril seems to be a modified branch, though other branches are found in the same leaf-axils. The tendril exhibits a pronounced circumnutation, and on coming into contact with a support coils round it two or three times, thus fixing the plant. The stimulus set up by the contact is, however, conveyed to the free part of the tendril next to the plant; this then twists spirally, say, into a dozen coils each way, for since both ends of the tendril are fixed any twist in one direction must be compensated by an equal contrary twist (Fig. 82). The effect of this coiling is, obviously, to raise the plant.

The tendril is undoubtedly very sensitive to touch; the coiling can indeed be induced by stroking the unattached tendril of a Pea, say, with a pencil. But the stem-twiners above mentioned cannot be induced to coil by this means. Certain facts

Photo: S. Leonard Bastin.

The tendrils of such plants as the Vine and Bryony (shown above climbing up bracken) possess very sensitive climbing organs.

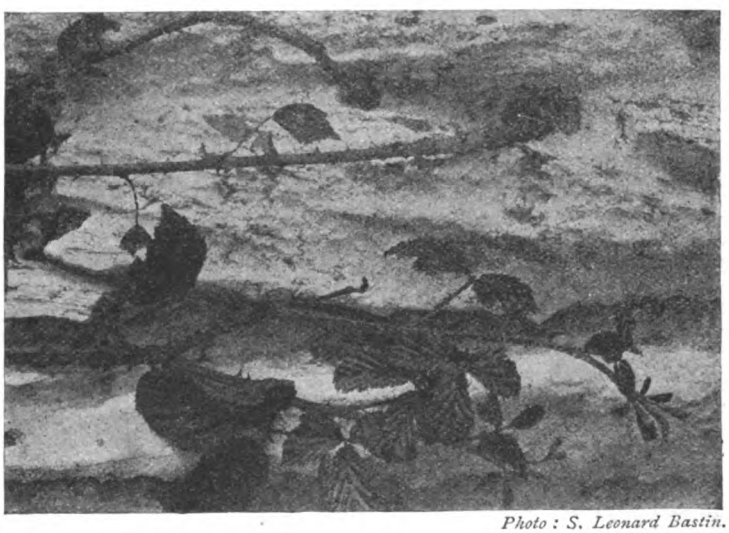


Photo: S. Leonard Bastin.

Ordinary Bramble branches "scramble" about the ground, adventitious roots forming at the swollen tips. From these roots new Bramble bushes, separate from the parent, may arise.

suggest that geotropism is, in some way, at least partially responsible for their behaviour; if a coiled scarlet-runner plant is kept for twenty-four hours in an inverted position, it will often uncoil itself, and try to twist in the opposite direction. The sensitiveness is thus complicated and interestingly mysterious in its causes.

Climbing is brought about by the curving of the petioles in the clematis or Old Man's Beard (Fig. 83). In ivy, of course, it is done by adventitious roots. The tendrils of the virginia creeper end in little pad-like swellings, by means of which it adheres to a wall or the like. The goosegrass, common in hedgerows, climbs by means of little hooked prickles which are very numerous on its stems. These examples illustrate the variety of the organs adapted to the climbing habit. The student should examine other cases like the Bitter-Sweet and the garden nasturtium for himself.

Fig. 79.—Wood-Sorrel: *a*, normal; *b*, leaf "asleep."

Fig. 80.—White Bryony.

Fig. 81.—Pea.

35. Other Plant Movements.—The most remarkable case of plant response to a definite touch-stimulus is found in the Sensitive Plant (*Mimosa pudica*). Although this plant does not grow native in Britain, it is common in greenhouses. If the midrib of one of the pinnæ of the compound pinnate leaves is lightly stroked, the leaflets soon fold together upwards in response to the stimulus; and if the stroking is vigorous, the leaflets in the other pinnæ show a similar, but not so prompt, response. If the petiole be gently pinched, not only do all the leaflets thus fold up, but the whole leaf droops limply from its base. And finally, if the main stem be pinched between the fingers, all the leaves droop in the same fashion.

After a time, dependent on the conditions, the leaves will be found to have recovered their normal positions. The drooping is also produced, though not so promptly, when the light is withdrawn, or when the plant is deprived of water or of oxygen; it occurs also regularly at nightfall.

This very delicate sensitiveness depends apparently upon the swollen leaf-base, here known as the *pulvinus*. When this is turgescent, or swollen with water, it is able to keep the leaf in its outspread position; but if water is withdrawn from it, it ceases to act as a supporting cushion for the leaf, and the leaf droops. Restoration of water causes it to act as before. Thus, in some way, the contact-stimulus affects the water-contents of the pulvinus, and deprives the leaf of its support.

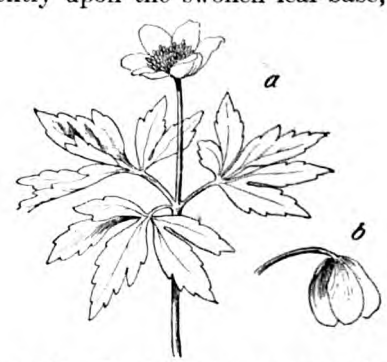


Fig. 84.—Wood Anemone: *a*, normal; *b*, leaf in cloudy weather.

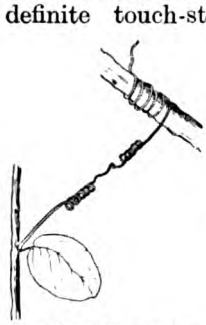


Fig. 82.—Tendril: Showing how a twist in one direction must be compensated by a contrary twist.

Fig. 83.—Clematis.

It must not be supposed that the plant has anything at all analogous to the nervous system of animals; it is merely fanciful to suggest that the plant *feels*.

The so-called *sleep-movements* of certain leaves and flowers are also in the nature of responses to external stimuli of various kinds,

though the mechanism of the response is not always easy to explain. The wood-sorrel is a delicate little plant of our woodlands, with ternate leaves which are exceedingly responsive to the absence of light or moisture. Ordinarily the leaves stand out during the daytime quite firmly, but towards nightfall the leaflets fall downward and fold, as shown in Fig. 79, the underside being enclosed and protected. The effect of this is to prevent an excessive loss of water vapour at night.

As we shall see in our next lesson, the loss of water in the form of vapour takes place chiefly from the underside of the leaf; and, as the vapour takes with it some of the heat of the plant—heat being necessary to cause the change of liquid water into vapour—the leaves are cooled; the sleep-movements thus prevent an excessive loss of water and excessive cooling at the same time, both of which might be dangerous to so delicate a plant. No doubt also the loss of water during the day is in some way the cause of the sleep-movement itself; when the loss of water has reached a certain point the plant thus protects itself against further excessive loss.

Effect of Light

This explanation cannot be accepted, however, as a general one, and probably does not represent the whole truth even in the case of the wood-sorrel. The leaflets of clover fold upwards instead of downwards, and thus the water is not husbanded as in the wood-sorrel; but probably there is less loss of heat by radiation when the leaves are in the vertical position; dew is not found so plentifully upon such leaves as upon others. Acacias and other tropical plants show similar leaf-movements in a greater degree.

Some of our most familiar wild flowers also close at night, or when daylight is otherwise obscured. The heads of daisies have this habit; and the partial closing of the wood anemone when a cloud passes over the sky is easily seen (Fig. 84). The scarlet pimpernel begins to close up its petals soon after midday. On the other hand, the white campion and evening primrose are closed during the day, and do not open till evening.

How the alternation of light and darkness can produce such various results, it is not easy to suggest. That change of temperature contributes something to the result in some cases can be observed when the wood anemone refuses to open in a cold wind, even on a clear day; and a tulip, it may be added, brought from outside into a warm room, soon opens. E. W. E.

MINERALOGY.—IV

CONTINUING our description of the minerals, the next group to which we come is:—

III.—HALOIDS

1. Rock Salt.

NaCl. *Cubic, occurring in cubes with a perfect cubic cleavage.* H = 2½. *Sp. gr.* = 2·2. *Colourless, transparent. Taste, saline. Soluble in water.*

Salt deposits are found among sedimentary rocks of all ages. They include a large number of other minerals, as the list given below amply shows, but of these Salt is the chief. They have been formed by the evaporation of inland seas under practically the same conditions as the Salt deposits of the Caspian Sea and the Dead Sea. When a natural water is evaporated it deposits its load of Salt and other constituents, the least soluble coming out first, the most soluble last. For this reason many Salt deposits lie on an earlier deposit of gypsum or anhydrite. The most famous example is that of Stassfurt, where the succession is as follows, going from the surface downwards:

1. Drift.
2. Shales, sandstones, and clays.
3. Rock Salt, NaCl } Second period of evapor-
4. Anhydrite, $CaSO_4$ } ation.
5. Clay.
6. Carnallite, $KCl.MgCl_2.6H_2O$, with—
   Rock Salt, NaCl.
   Sylvite, KCl.
   Kainite, $MgSO_4.KCl.3H_2O$.
7. Kieserite, $MgSO_4.H_2O$.
8. Polyhalite, $2CaSO_4.MgSO_4.K_2SO_4.2H_2O$, with Langbeinite, $2MgSO_4.K_2SO_4$.
9. Rock Salt, NaCl, alternating with—
   Anhydrite, $CaSO_4$, with—
   Glauberite, $CaSO_4.NaSO_4$.
10. Anhydrite, $CaSO_4$, with—
    Gypsum, $CaSO_4.2H_2O$.

2. Fluor Spar or Fluorite.

CaF_2. *Cubic, occurring in cubes with perfect cubic cleavage.* H = 4. *Sp. gr.* = 3·2. *Colour, purple, etc. Streak, white. Transparent.*

Fluor is a beautiful mineral occurring chiefly in mineral veins, and is especially associated with lodes of galena, zinc blende, and tinstone. It varies widely in colour: yellow, blue, violet, rose, and green tints being common. Beautiful crystals have been found at Weardale and Alston in the north of England, and in Derbyshire it is worked under the name of "Blue John" into vases and other ornaments. For commercial purposes it is used (in metallurgical processes) as a flux, and it provides the only source of hydrofluoric acid.

3. Cryolite.

Na_3AlF_6. *Triclinic, but occurs in cube-like crystals with a cube-like cleavage.* H = 2½. *Sp. gr.* = 3·0. *Colourless. Streak, white.*

As the name indicates, Cryolite (Ice Stone) is like ice in appearance, and when a fragment is placed under water it seems to disappear. The mineral is important as having been the only source of aluminium until bauxite began to be used, and even in the modern processes cryolite is a necessary

flux. It is found in workable quantities only in the west of Greenland, where an enormous mass occurs in granite-pegmatite, associated with sulphide minerals and cassiterite.

4. Other Haloid Minerals.

In addition to the haloid minerals mentioned in Section III (1)—sylvite, KCl, and carnallite, $KCl.MgCl_2.6H_2O$—there are a few other chloride minerals of importance, *Kerargyrite*, or *Horn Silver*, AgCl, and *Atacamite*, $CuCl_2.3Cu(OH)_2$, being the chief. Kerargyrite is a soft, horny, cubic mineral, formed as a secondary product in association with argentiferous galena and other silver ores. Atacamite is a green orthorhombic mineral with an apple-green streak. It occurs in association with other copper ores, but only in arid countries, as in Chile.

IV.—SULPHIDES, ARSENIDES, ETC.

These may be classified as follows:—

2. Zinc Blende or Sphalerite.

ZnS. *Cubic, occurring in rhombdodecahedra and tetrahedra, with a perfect dodecahedral cleavage.* H = 3½. *Sp. gr.* = 4. *Colour, yellow and brown. Streak, pale yellow. Lustre, adamantine.*

Blende is the most important zinc ore, and, like galena, with which it is usually associated, it is a common constituent of mineral veins. The oxidation products are calamine, $ZnCO_3$, and willemite, Zn_2SiO_4.

3. Cinnabar.

HgS. *Hexagonal. Colour, cochineal red. Streak, vermilion.* H = 2½. *Sp. gr.* = 8·2. *Lustre, adamantine.*

This mineral is usually found in massive earthy aggregates, good crystals being rare. It is the principal ore of mercury, and most of the world's

	Name	*Composition*	*System*	*H*	*Sp. gr.*	*Streak*
Monosulphides.	Copper Glance	Cu_2S	Orthorhombic	2·5	5·7	Black.
	Argentite ..	Ag_2S	Orthorhombic	2	7·3	Grey.
	Galena.. ..	PbS	Cubic	2·5	7·5	Grey.
	Blende.. ..	ZnS	Cubic	3·5	4·0	Yellow.
	Greenockite ..	CdS	Hexagonal	3·5	4·9	Orange.
	Millerite ..	NiS	Hexagonal	3·5	5·5	Greenish black.
	Niccolite ..	NiAs	Hexagonal	5·5	7·5	Brown.
	Covellite ..	CuS	Hexagonal	2	4·6	Grey.
	Cinnabar ..	HgS	Hexagonal	2·5	8·2	Vermilion.
	Pyrrhotite ..	$(FeS)_nS$	Hexagonal	4	4·6	Grey.
Disulphides.	Pyrite	FeS_2	Cubic	6	5·1	Greenish black.
	Cobaltite ..	CoAsS	Cubic	5·5	6·2	Grey.
	Smaltite ..	$CoAs_2$	Cubic	5·5	6·2	Grey.
	Chloanthite ..	$NiAs_2$	Cubic	5·5	6·5	Grey.
	Marcasite ..	FeS_2	Orthorhombic	6	4·8	Greenish grey.
	Mispickel ..	FeAsS	Orthorhombic	5·5	6·0	Grey.
	Molybdenite ..	MoS_2	Hexagonal	1·5	4·7	Bluish grey.
	Realgar ..	As_2S_2	Monoclinic	1·5	3·5	Orange.
Sesqui-sulphides.	Orpiment ..	As_2S_3	Orthorhombic	2	4·0	Yellow.
	Stibnite ..	Sb_2S_3	Orthorhombic	2	4·6	Grey.
	Bismuthite ..	Bi_2S_3	Orthorhombic	2	6·4	Lead grey.
Sulpho-compounds.	Copper Pyrites	$CuFeS_2$	Tetragonal	4	4·2	Greenish black.
	Stannite ..	Cu_2FeSnS_4	Tetragonal	4	4·4	Black.
	Erubescite ..	Cu_3FeS_3	Cubic	3	5·0	Grey.
	Tetrahedrite ..	Cu_3SbS_3	Cubic	3·25	4·7	Dark brown.
	Pyrargyrite ..	Ag_3SbS_3	Hexagonal	2·5	5·8	Purple.
	Proustite ..	Ag_3AsS_3	Hexagonal	2·5	5·6	Scarlet.
	Bournonite ..	$PbCuSbS_3$	Orthorhombic	2·5	5·8	Grey.

1. Galena.

PbS. *Cubic, occurring in cube and octahedron forms, with a perfect cubic cleavage.* H = 2½. *Sp. gr.* = 7·5. *Colour and streak, lead grey. Lustre, metallic*

Galena is the commonest ore of lead, and as it frequently contains silver the latter may be even more valuable than the lead itself. Galena is easily recognised by its cubic cleavage, which is seen in the granular and massive varieties as well as in crystals. It is a very frequent constituent of metalliferous veins, where it is found in company with blende and copper pyrites, and with calcite, barytes, fluor, and quartz as the usual vein minerals or *gangue*.

supply comes from Almaden, in Spain, and Idria, in Austria.

4. Pyrite.

FeS_2. *Cubic, occurring in cubes, octahedra and pyritohedra.* H = 6. *Sp. gr.* = 5·1. *Colour, pale brass yellow. Streak, greenish black. Lustre, metallic.*

Pyrite is perhaps the commonest and most widespread of all the metallic minerals, and it is found under the most varied conditions. Besides occurring in good brassy crystals, it forms massive and granular deposits, builds nodules, and replaces fossils. It is a primary constituent of igneous rocks, a common mineral in metalliferous veins, and is distributed in clays and coal formations.

The orthorhombic form of FeS_2, *Marcasite*, occurs in fibrous, radiating, and concretionary forms. It is less stable than pyrite, into which form it readily passes; it is also more easily oxidised. Another sulphide of iron, *Pyrrhotite*, or Magnetic Pyrites, is hexagonal, and always has a little more sulphur than the proportion expressed by the formula FeS, being commonly $Fe_{11}S_{12}$. *Troilite* is true FeS, and occurs only in meteorites. Pyrrhotite occurs in igneous rocks, and may be distinguished by its bronze colour and its magnetic character.

5. Copper Pyrites or Chalcopyrite.

$CuFeS_2$. *Tetragonal.* H = 4. *Sp. gr.* = 4·2. *Colour, brass yellow, often tarnished. Streak, greenish black. Lustre, metallic.*

This mineral is the most important ore of copper. It occurs in metalliferous veins in association with other sulphides. It is very liable to tarnish, and some iridescent varieties are known as "Peacock Copper." This feature and its relative softness serve to distinguish it from iron pyrites. *Copper Glance*, Cu_2S, is a secondary mineral formed from Copper Pyrites. It is of a lead-grey colour, frequently tarnishing to blue owing to the formation of the rare blue sulphide, Covellite, CuS. Next in importance among the commercial ores of copper is *Erubiscite* or *Bornite*, Cu_3FeS_3, a reddish-brown bronze mineral, often with a blue tarnish which gives it the name "horseflesh ore." Another copper ore of local importance is *Tetrahedrite*.

6. Ores of Silver.

Argentite, Ag_2S, occurs in lead-grey irregular cubes, and in platy and dendritic masses. It is very easily fused, and can be cut with a knife like lead. The other ores of silver, *Pyrargyrite*, Ag_3SbS_3, and *Proustite*, Ag_3AsS_3, somewhat resemble cinnabar. The latter, however, is completely volatile before the blowpipe, whereas the silver ores melt, giving characteristic fumes of antimony or arsenic. The streak of Proustite is lighter in colour than that of Pyrargyrite.

V.—CARBONATES

Carbonates may be classified as follows:—

1. Calcite.

$CaCO_3$. *Hexagonal, with perfect rhombohedral cleavage.* H = 3. *Sp. gr.* = 2·72. *Colourless. Transparent. Streak, white. Lustre, vitreous. Effervesces with* cold *dilute acids.*

Calcite is one of the commonest of minerals. As a massive rock it forms limestone and marble. It is a common cementing material in other sedimentary rocks, and, except perhaps for quartz, the most usually found vein-filler. Its widespread distribution is due to its solubility, as $CaH_2(CO_3)_2$, in waters containing CO_2. In crystals it occurs as beautiful transparent prisms terminating in rhombohedron faces, known as "nail head" spar, and also as scalenohedra with or without prisms, in which case it is known as "dog tooth" spar. The rhombohedral cleavage is so perfect that calcite can at once be recognised by this property, often, when there are internal fractures, at a glance. It is the type of the isomorphous rhombohedral carbonates listed below.

Dolomite, the double carbonate of calcium and magnesium, occurs in simple rhombohedra, which are often curved and saddle-shaped. It often has a pearly lustre, which, when it has a pale yellow colour, has earned for it the name "pearl spar." The brown varieties contain iron, replacing part of the magnesium. Dolomite together with calcite forms the Magnesium Limestone of Durham and the "Dolomite" ranges of the Tyrol. See also Section V (3) for a test to distinguish calcite and dolomite (p. 400).

2. Chalybite or Siderite.

$FeCO_3$. *Hexagonal, with a perfect rhombohedral cleavage.* H = 3½. *Sp. gr.* = 3·8. *Colour, brown and grey. Streak, white. Effervesces in* warm *acid.*

Chalybite, like dolomite, occurs in rhombohedra, and in concretionary and globular masses it is common in the clays of the Coal Measures, where it constitutes the ore known as "clay ironstone." The mineral is deposited from bicarbonate solutions, but under non-oxidising conditions, as, for example, under the influence of decaying vegetation. Under

Name	*Composition*	*System*	*H*	*Sp. gr.*	*Streak*
Calcite	$CaCO_3$	Hexagonal Rhombohedral	3	2·72	White.
Dolomite	$CaMg(CO_3)_2$		3·5	2·85	White.
Magnesite	$MgCO_3$		4	3·1	White.
Ankerite	$Ca(Mg,Fe)(CO_3)_2$		3–4	3·0	White.
Chalybite or Siderite	$FeCO_3$		3·5	3·8	White.
Rhodocrosite	$MnCO_3$		4	3·5	White.
Calamine	$ZnCO_3$		5	4·4	White.
Baryto-calcite	$CaBa(CO_3)_2$	Monoclinic	4	3·65	White.
Aragonite	$CaCO_3$	Orthorhombic	3·5	2·9	White.
Bromlite	$CaBa(CO_3)_2$		4	3·7	White.
Witherite	$BaCO_3$		3·5	4·3	White.
Strontianite	$SrCO_3$		3·5	3·7	White.
Cerussite	$PbCO_3$		3·5	6·5	White.
Malachite	$(CuOH)_2CO_3$	Monoclinic	3·5	4·0	Green.
Azurite, Chessylite	$Cu(CuOH)_2(CO_3)_2$		4	3·8	Blue.
Natron	$Na_2CO_3.10H_2O$		1—1·5	1·45	White.

oxidising conditions iron hydroxides would be formed from the same solutions.

The other important carbonates of the rhombohedral group are the pink *Rhodocrosite*, $MnCO_3$, and the white (but often coloured by impurities) *Calamine*, $ZnCO_3$. Of these crystals are rare, and the latter especially tends to occur in botryoidal and earthy masses.

3. Aragonite.

$CaCO_3$. *Orthorhombic.* H = 3½. *Sp. gr.* = 2·9. *Colourless. Transparent. Lustre, vitreous. Effervesces with cold dilute acids.*

This, the orthorhombic form of the dimorphic calcium carbonate, is far less common than calcite, owing to the fact that it is unstable at ordinary temperatures. It is commonly formed from *hot* solutions, whereas calcite forms from cold. Around hot springs Aragonite forms crusts, botryoidal and coral-like masses. In crystals it frequently has a pencil-like habit, due to the development of long, sharply pointed pyramids. To distinguish the dimorphic forms of calcite, Meigen's test is useful. Boiled in pure cobalt nitrate, Aragonite is stained lilac-red, and calcite remains white or may take on a bluish hue. A similar test may be used to distinguish calcite and dolomite (Lemberg's test). A cold solution of aluminium chloride and logwood stains calcite to a violet colour, leaving dolomite unaffected.

Some organisms have skeletons of Aragonite, e.g. corals, lamellibranchs, and most gastropods.

4. Other Orthorhombic Carbonates.

Strontianite, $SrCO_3$, and *Witherite*, $BaCO_3$, are vein minerals, not very common, associated generally with galena, barytes, $BaSO_4$, and celestine, $SrSO_4$. *Cerussite*, $PbCO_3$, occurs in brilliant translucent crystals with an adamantine lustre, and is found in most lead mines as an alternative product of galena, next to which it is the commonest ore of lead. These carbonates with Aragonite form a well-marked group of isomorphous minerals.

5. The Basic Carbonates of Copper.

Azurite (or *Chessylite*), $Cu(CuOH)_2(CO_3)_2$, blue, and *Malachite*, $(CuOH)_2CO_3$, green, are very striking minerals on account of their bright colours. They are invariably found together as secondary products in the upper portions (oxidised) of copper lodes, and Azurite readily passes into Malachite by further hydration. Azurite occurs in deep-blue lustrous crystals, and also in earthy, nodular and botyroidal, and banded masses. Its green companion is rarely crystallised, but is common in nodular, botryoidal, and banded forms. The banded varieties of both minerals are used for ornamental purposes.

Mention may also be made here of the silicates of copper. *Chrysocolla*, $CuSiO_3.2H_2O$, occurs like malachite in green or blue amorphous masses. Its white streak serves to distinguish it from the carbonates and from *Dioptase*, H_2CuSiO_4, which, although a rare mineral, occurs in beautiful emerald-green crystals (hexagonal), and has a streak of the same colour. Both minerals are used for ornamental purposes, Chrysocolla as imitation turquoise and Dioptase as a gem.

A. H.

ZOOLOGY.—XXV

WHILE our review of the true fishes has been necessarily imperfect owing to the almost infinite number of existing variations, an endeavour has been made to afford the reader some indication of the characteristics which primarily distinguish the better-known fishes. To complete this survey it is necessary to deal briefly with a few aquatic animals which are to be found living freely in the ocean, though they are not, within the strict sense of the word, fishes.

Lampreys and Hag Fishes

Of the groups concerned the *Cyclostomi* or Lampreys and Hag Fishes just miss inclusion in the higher order from the absence of the hinged lower jaw by which all true fishes are distinguished. In the Lamprey and the Hag Fish the mouth is round, and is closed not by the bringing together of upper and lower jaws, but by the contraction of the right and left margins. The body is long and destitute of scales. The nostril is single in both instances, but in the Lamprey is placed far back on the top of the head. Lampreys deposit their spawn in the rivers in the spring, in most cases ascending from the sea for this purpose. Their distribution is world wide.

Carnivorous by nature, the Lamprey supports life by feeding upon living fishes to which it attaches itself by means of its sucker-like mouth. The fish is seldom able to free itself from this horrible attack, and is gradually eaten alive by the horned teeth with which the mouth of the Lamprey is well provided. The River Lamprey is well known in English waters, being taken, its name notwithstanding, frequently in the sea.

The Hag Fish has a very wide distribution, is entirely marine, and is often found at great depths. Like the Lamprey it is carnivorous, and is responsible for great depredations amongst some valued food fishes. The Cod fishery is one to which it is especially harmful. In this case the Hags in great numbers attack the hooked fish and literally bore their way into its body. Captured or marined fish appear to be the usual prey of the Hag Fish. The Common Hag Fish of the North Atlantic is responsible for most of the damage done to the British Cod Fisheries.

The Ascidians or Sea Squirts during the larval period of their lives offer some resemblance to the tadpole or a frog, but in an

adult stage, except in a few instances such as the Appendicularia, the tail is absent. At this stage, also, the Ascidians possess no distinct head, arms or legs.

Despite the fact that they lack bony skeletons, the Ascidians and Lancelets have in common certain anatomical characteristics which are shared by all vertebrate animals. They stand, indeed, at the foot of the *Vertebrata*, at the base of the column which ascends through Fishes and Amphibians, Reptiles and Birds up to Man himself.

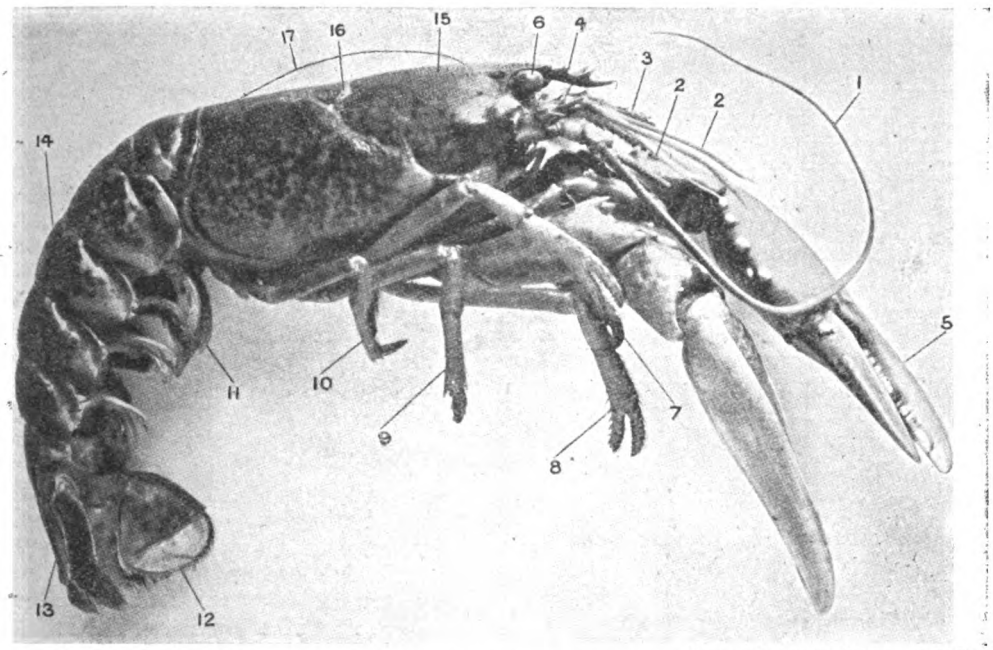


Photo: F. Martin Duncan, F.R.P.S.

COMMON LOBSTER.

1. Antenna.
2. Antennule.
3. Third maxilliped.
4. Rostrum.
5. Cheliped, or first leg.
6. Eye.
7–10. Walking legs.
11. Pleopods, or swimmerets.
12. Uropod } Tail fan.
13. Telson }
14. Abdomen somites.
15. Carapace.
16. Cervical groove.
17. Cephalothorax.

Crustacea

The *Crustacea* is a most interesting class which includes the Lobsters, Crabs, Shrimps, Prawns and many other known and, it might almost be said, unknown creatures. At any rate it includes in addition to some generally recognised forms of life others to which no popular name has been given, and of which the very appearance, except to the more expert Naturalist, is unknown. Even the characteristics which serve to place certain creatures within the class are rather hard to define.

It will suffice here to show the most obvious points of difference between the Crustacea and the three other classes which are grouped with it in the *Arthropoda*. One outstanding difference is found in the number of "walking-legs." In the Insecta, as we shall see, these are six in number, in the *Arachnida* eight, while in the Centipedes and Millipedes the legs are, of course, very numerous indeed. But the Crustacea as a class conform to none of these rules; but rather, as it were, determine the number and arrangement of their legs to suit the habits and general convenience of each species. As a more positive characteristic, it may be noted that the *Crustacea* carry two pairs of antennæ before the mouth, and at least three pairs of jaw-like appendages behind it. Most members of the class are essentially fitted to live in water, breathing generally by gills.

In most species the young of the *Crustacea* pass through numerous moults before reaching the adult form, and even after maturity the shell is cast from time to time in order to permit of an increase in the bulk of the wearer.

But for its ability to cast its shell, the lobster or the crab would perforce follow

the same rule since its body is completely covered by a hard and horn-like substance known as "chitin." This substance is continuous even over the joints, though at such parts it becomes thinner and softer, and everywhere it is inelastic. In the process of moulting a split occurs in this substance through which the lobster or crab withdraws itself, the discarded covering being left where it lies, practically intact. The new shell has developed beneath the old, and though soft is already perfectly formed when the old shell is dispensed with.

As is generally known, the *Crustacea* possess the power of reproducing injured or lost limbs. This is not perfectly accomplished at the next moult, the place of the missing limb being taken at first by one of more or less diminutive proportions. After about the third moult, however, the lost limb has been completely regained.

The best-known Crustaceans are included in the order *Decapoda*, meaning "Ten-legged," which is again split into several sub-orders, the first of which, the *Brachyura*, contains the true crabs.

Crabs are said to be the highest representatives of the *Crustacea;* they are far more agile than they are generally supposed to be, and, what is more surprising, they are more intelligent.

Common Shore Crab

The Common Shore Crab spends much of its time out of the water, and may be seen almost anywhere on our coasts between high and low watermarks. It is a most interesting inmate for the aquarium where sea water is to be obtained, and rapidly loses its shyness. The swimming crabs, of which this species is in a sense representative, possess flattened hind feet, a feature which is of assistance when the legs are required to propel the body through water. A much larger species of Swimming Crab, the *Portunus pelagicus*, is found in the seas of China and Japan. This creature is often, and quite accurately, represented in Japanese prints as overtaking and killing fish many times larger than itself.

A notable example of the force of instinct is provided by the *Gecarcinus ruricola* or "Countryman Crab" of the West Indies which, when the spawning season arrives, marches from great distances inland direct to the sea in order to deposit its eggs below high-water mark. This work accomplished, these determined creatures return to their inland haunts amongst the sugar-canes. In India and elsewhere, it may be noted, crabs are often found at such enormous distances from the sea as quite to preclude an annual tramp to salt water. In such cases it is probable that the eggs are deposited upon the margin of the nearest lake or river.

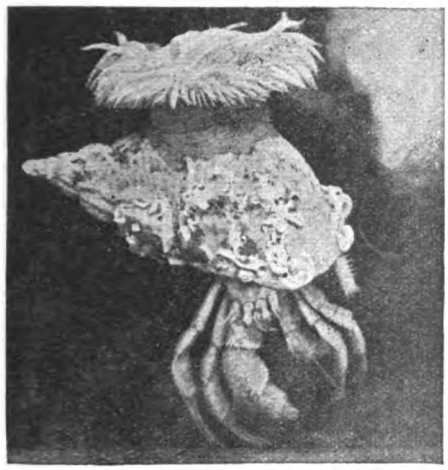
The Giant Japanese Crab has the distinction of being the largest of all the *Arthropoda*. When its claws are outstretched it measures no less than eleven feet from tip to tip. This crab is one of several which practise the very clever ruse of affixing vegetable matter to the carapace in such a fashion as to disguise their appearance. Others cultivate green and red seaweed upon their backs and thus contrive to stalk their more active prey. Where a mere collection of seaweed may prove to be an accomplished and ferocious assassin, the life of the innocent is far from being happy.

The Hermit Crab

The sub-division *Anomura* comprises a group of irregular tailed crabs which are regarded as forming a connecting link between the crab and the lobster. The Hermit Crab is particularly interesting from its habit of appropriating the shell of some mollusc. In the British Museum (Natural History) one of these creatures may be seen ensconced in the shell of a whelk which appears as though it had been made for it. Charles Darwin remarks, "In every part of Keeling Island one meets with Hermit Crabs of more than one species, carrying on their backs the houses they have stolen from the neighbouring beach."

The Marine Hermit Crabs of the family *Paguridæ* usually attach sponges or sea anemones to their shells. Doubtless both forms of life, the attacher and the attached, gain from their union an increased supply of food. A peculiar case is that of the *Paguropsis typica*, which carries no shell and protects its abdomen by a cloak of living sea anemones, which it holds in position by its hinder legs. The *Birgus latro*, which does not carry a portable dwelling, climbs certain trees to obtain its fruit. Charles Darwin in *A Naturalist's Voyage Round the World* describes the manner in which the crab cracks and eats coco-nuts. It begins by "tearing the husk, fibre by fibre, and always from that end under which the three eye-holes are situated. When this is completed, the crab commences hammering with its heavy claws on one of the eye-holes until an opening is made."

The Stone Crab, though closely related, anatomically, to the Hermit Crab, has a highly calcified shell.



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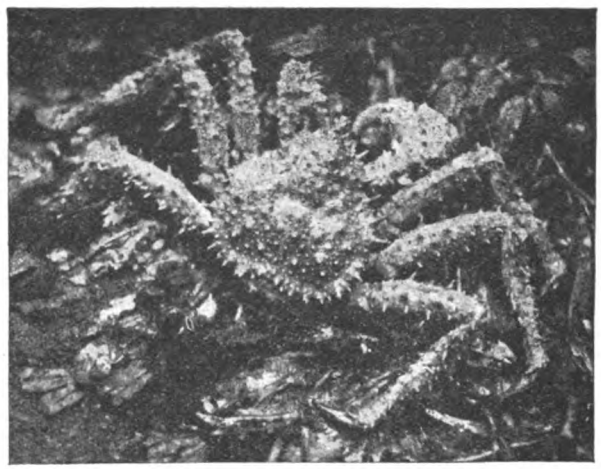

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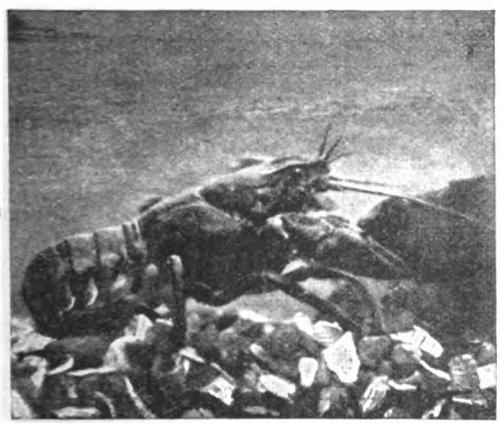

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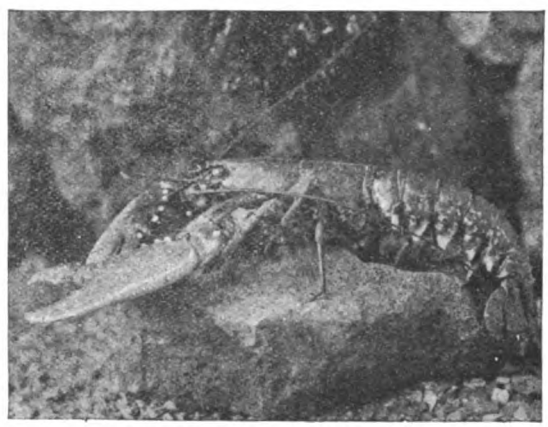

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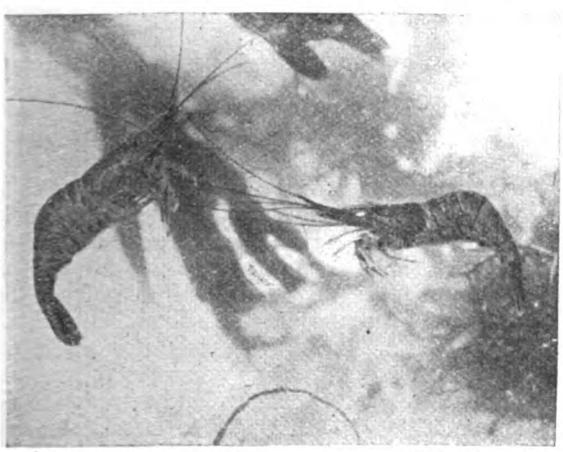

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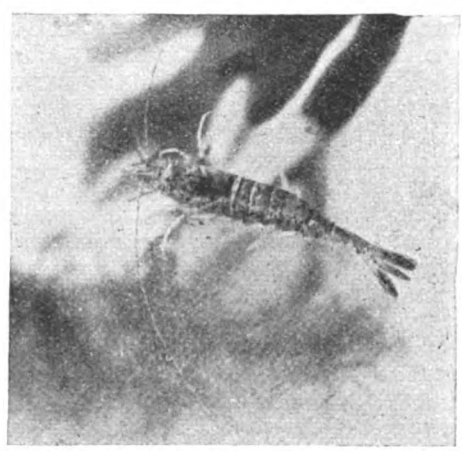

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Photos: 1, 2, 3, 5 *and* 6: *W. S. Berridge*; 4: *F. Martin Duncan, F.R.P.S.*

CRUSTACEA.

1. **Hermit Crab with its Commensals.**
2. **Northern Stone Crab.**
3. **Cray Fish.**
4. **Common Lobster** (cf. p. 401).
5. **Prawns.**
6. **Shrimp.**

The Lobsters are found in the sub-division *Macrura* of long-tailed Crustaceans. They are essentially aquatic and are possessed of great powers of locomotion. The true lobsters and cray fishes of the tribe *Astacidea* may be recognised by the first three pairs of legs which are furnished with pincers, and of which the first pair, popularly known as the "claws," are very large.

The Common Spring Lobster, a well-known species, but not a "true lobster," is found on the southern and western coasts of the British Isles, where it favours a rocky district, and is often taken in crab-pots. It reaches from one foot to eighteen inches in length. The flesh of this lobster is greatly esteemed, though probably not to the extent of that of the common lobster. The two species may be readily detected by the true walking legs which, in the first case are one-toed at the extremity, and in the second are in pincer form.

Common Lobsters

The Common Lobster is taken in great numbers off rocky coasts, and is sometimes delivered at Billingsgate in numbers exceeding 25,000 in one day. From March to August is the period of the greatest catch. Accustomed as we are to seeing this creature in its perfect form, we frequently fail to realise the great difference that it thus presents from the young lobster just emerged from the egg. At such a time it has no claws, and in the setting of the eyes and the form of the body there is very little to suggest the pronounced shape which we generally associate with the word "lobster." The Norway Lobster frequents deeper water than the Common Lobster.

The Common Cray Fish, which may be found in our rivers or hiding under stones or in holes in the bank, very greatly resembles the marine lobster in appearance. It feeds upon dead fish and similar substances, and is itself valued as a table dish. Some confusion occasionally results from the fact that both this species and the Red Clawed Cray Fish are designated by the same generic name. It should be noted that the last-mentioned species, which is the largest of the cray fishes found in Western Europe, is common to France, Germany, Russia and Denmark.

The Common Brown Shrimp is taken in great numbers in the estuaries of some rivers. It is of a drab colour, dotted with brown spots, and, contrary to popular belief, does not become red, as is the case with other Crustaceans, when boiled. The so-called shrimp of pink colour sold by the fishmonger is in reality the Common Prawn. It may be distinguished from the Common Brown Shrimp by its long beak, that of the shrimp being short and smooth.

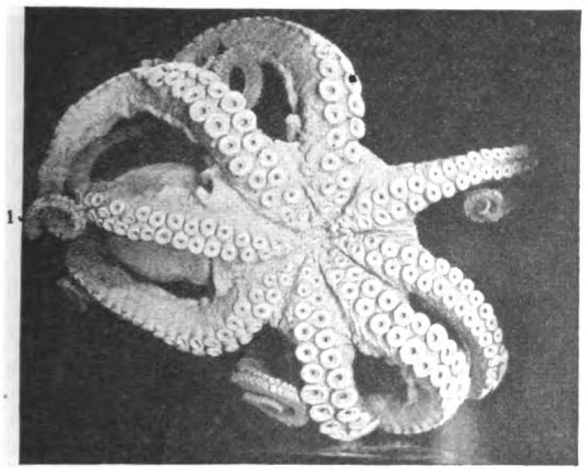
The interest displayed by some people in the great sub-kingdom of soft-bodied animals known as the *Mollusca* is generally in inverse proportion to its real importance. This fact may be accounted for, probably, by the absence of any very striking personality or well-known figure amongst the creatures concerned. The Ants and the Bees of the *Insecta*, the homely Spiders of the *Arachnida*, the Lobster and the Crab amongst the *Crustacea*, all tend to draw attention to other equally interesting but less generally recognised types of life.

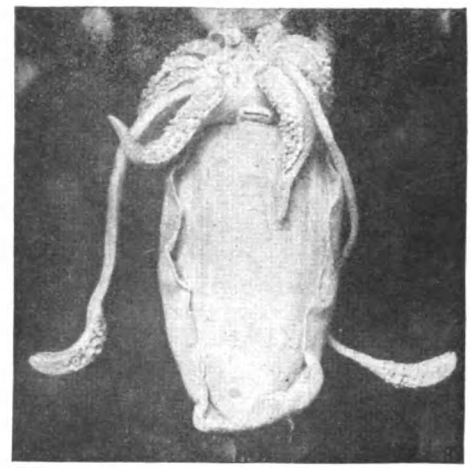
In the *Mollusca*, however, we are faced for the most part by creatures which even when we are familiar with their appearance, scarcely excite our wonder. The Octopus and Squid, strange and fearful as in some respects they undoubtedly are, scarcely thrill the imagination as does the Shark. There is something remote and distantly impossible about a Squid. As for Oysters and Snails, their greatest admirers would scarcely point to them as fitting subjects for the enthusiasm of the uninitiated. None the less, those who are prepared to devote some study to the *Mollusca* inevitably reap a rich reward, for life amongst these creatures, though less "direct," if the term may be permitted, than amongst some higher forms yet exhibits an amazing ingenuity of effort.

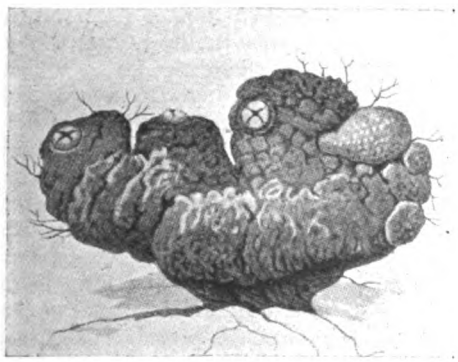
The Mollusca

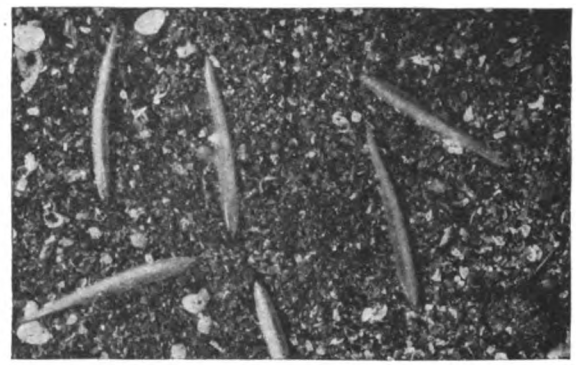
The *Mollusca* are to be found in all countries and practically in every condition in which life anywhere exists. The majority are marine, some inhabit the narrow belt between high- and low-water mark, others the bottom of the ocean, some are found in the shallowest water. others have been dredged from a depth of five miles from the surface. Thousands of forms frequent rivers and lakes, thousands more live in mountains and valleys, in forests and in deserts. One condition alone appears to be essential to the life of the *Mollusca*, and that is the presence of moisture. All are without an internal bony skeleton, but the majority are protected by a hard shell.

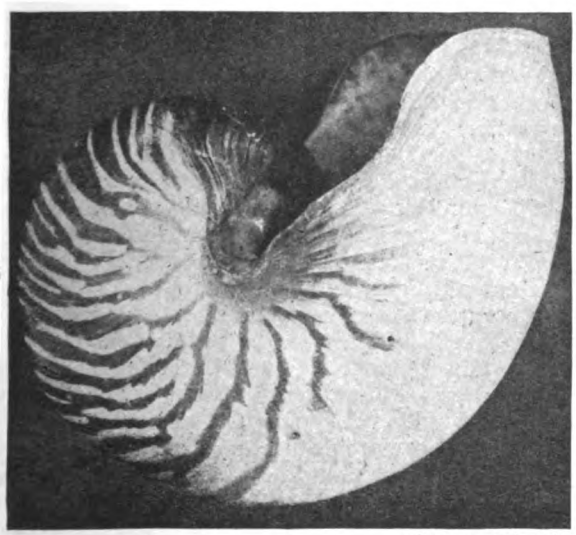
The breathing organs are interesting anatomical features in all the *Mollusca*, and especially so in the case of the *Lamellibranchia* to which the Oyster and the Mussel belong. In this group no head is

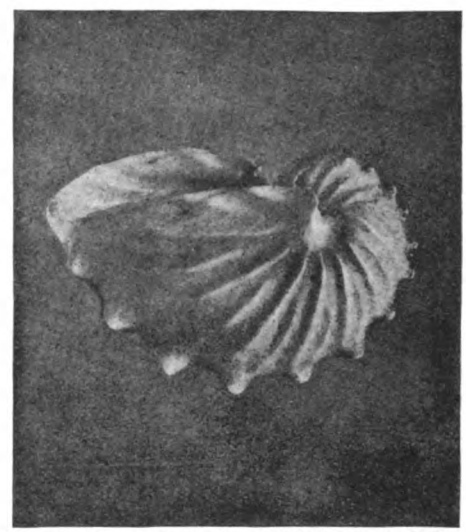












Photos: 1 and 2: W. S. Berridge; 4, 5 and 6: F. Martin Duncan, F.R.P.S.

MOLLUSCA.

1. Octopus.
2. Cuttle Fish.
3. Ascidian or Sea Squirt.
4. Lancelets.
5. Pearly Nautilus.
6. Argonaut or Paper Nautilus.

to be found, neither is there any apparent means by which food can be carried to the organs of the body. It is in these circumstances that the so-called gills become all important, for attached to them are waving filaments which cause currents in the surrounding water. Thus through the agency of the water the breathing organs provide the mouth with the minute organisms upon which the body lives. The organs of hearing are scarcely less curious.

The very interesting suggestion has been made that in many species the so-called ear is the medium through which the Mollusc becomes acquainted with the changes in the surface over which it is passing. This ear in the *Cephalopoda* makes its first appearance in the form of an open pit, the mouth of which gradually closes up, leaving only a narrow slit in communication with the exterior.

A Million Eggs!

Reproduction in the *Mollusca* is in every case by eggs. But whilst the sexes are distinct in some of the higher forms, in others such as the Land Snails and the Bivalves they are united in the same individual. The dangers to which the eggs are exposed are compensated for by the immense number produced by the individual of some species. The Common Oyster is said to produce a million or more, the American Oyster as many as sixty millions.

The *Cephalopoda*, a class in which the head and body are surrounded by eight or ten tentacles, includes the Octopus, the Cuttle-fish, the Squid, the Argonaut or Paper Nautilus, and the beautiful Pearly Nautilus.

Of this unprepossessing group the Octopus is probably the strangest member. It is the eternal antithesis to the probable. It possesses eyelids, but never closes them ; it walks, but head downwards ; it swims, but backwards ; it conveys the impression of endless time, and dies after a short life of four years.

Some forty-six species of Octopus are known to naturalists, and their distribution extends to nearly all rocky coasts, both in temperate and tropical regions of the earth. No Octopus attains to a very large size ; tentacles of from four to five feet in length and of the thickness of a man's wrist denote a specimen of much more than average weight.

The tentacles are uneven in length, and each carries two rows of terribly efficient suckers; the body is a muscular sac from which the head vaguely projects ; the skin is dark in colour. To this unpleasant picture must be added a funnel which issues from the body under the head and through which the Octopus ejects the water which has passed over its gills.

This funnel, however, has stranger uses. Expulsions more violent than usual drive the ungainly body backward, and it is in this manner that the Octopus, when it desires to travel quickly, actually propels itself. There remains one further use to which this remarkable apparatus is put, for in time of danger the Octopus expels from it a quantity of inky fluid under cover of which it makes its escape.

As is scarcely surprising in a creature of such strange parts, this animal has figured largely in myth and romance, generally it must be admitted, with added horrors.

It is the habit of the Octopus to conceal itself throughout the day in some hole amongst the rocks, and to issue after dark in search of prey. Mr. Henry Lee, F.R.S., who made a special study of this Mollusc, records in " Aquarium Notes " an experience bearing on this point. " The Octopus, like many other predaceous animals who seek their prey by night, habitually returns to skulk in the same retreat in the daytime."

Habits of the Octopus

" This practice enabled the resident Octopus of the Brighton Aquarium to enjoy, for many weeks, the run of all the neighbouring tanks by night undetected, for, like the celebrated robber Peace, he was always to be found at home in the morning. But the rate at which he thinned the young Lump-fishes in an adjoining tank, led to grave suspicion, and after too hearty a meal one evening he imprudently stayed out all night, and was ' caught red-handed,' gorged to distension, next morning, in the Lump-fishes' abode."

The number of eggs produced by an Octopus ranges from about forty to fifty thousand. The young Octopus on emerging from the egg is quite small.

It swims about in sunlit waters, and does not at first adopt the hermit-like habits of its parents. It is an easy prey to many fish, and thousands perish in this way.

Fortunately in the economy of Nature the Octopus has been provided with more than one enemy, the most ferocious in British waters being the Conger-Eel. Some dog-fishes and the large *Crustacea* are also at times the agents of Nemesis. A. B.

Continued from page 351.

LANGUAGES:

Contributors:—LATIN, GREEK and FRENCH (E. A. Baker, M.A., D.Lit.). GERMAN (M. A. Lewenz, M.A.[Lond.]). SPANISH, RUSSIAN and ITALIAN (Alfred Calvert, First Prizeman in Modern Languages, R.S.A., London).

GERMAN.—XXVII

The Infinitive Governed by a Preposition.—Three prepositions—um, *in order to*, ohne, *without*, ſtatt or anſtatt, *instead*—can govern an Infinitive directly. Thus, er kam um ſeinen Bruder zu ſehen, *he came in order to see his brother ;* ich ging fort ohne meinen Zweck zu erfüllen, *I went away without fulfilling my object ;* wir zögerten anſtatt ſofort energiſch einzugreifen, *we hesitated instead of interposing energetically at once.*

In other cases when an Infinitive phrase depends on a preposition, the preposition is used in composition with da (or dar), where da takes the place of a pronoun, and the Infinitive phrase is in apposition to the pronoun represented by da. Thus, ſie ſprachen davon noch denſelben Tag abzureiſen, *they were talking of going away the same day* (they were talking of it, to go away the same day).

When the subject of the principal verb is different from the subject of the action indicated by the Infinitive, a Noun Clause must be used in apposition to the pronoun represented by da. Thus ſie rechneten darauf daß er kommen würde, *they counted on his coming* (they counted on it that he would come).

The Infinitive in Absolute Constructions.—This use of the Infinitive is similar to its use in absolute constructions in English. Thus, *why not go on ?* warum nicht weiter gehen ? auf das Thema zurückzukommen, *to return to the subject.*

But the Nominative Absolute with an Infinitive, which is fairly common in English, cannot be imitated in German ; instead, another Principal clause must be used. Thus, *we were to divide the money, he to have one half and I the other*, wir ſollten das Geld teilen, er ſollte die eine Hälfte haben, und ich die andere.

Infinitive Phrases.—Long Infinitive phrases are fairly common in German, and take the place of Noun Clauses ; in fact, the two forms of construction are interchangeable. Thus, er beſchäftigte ſich damit den ſeit langen Jahren vernachläſſigten Garten wieder in Ordnung zu bringen, *he occupied himself in putting in order the garden which had been neglected for many* (long) *years ;* or, er beſchäftigte ſich damit daß er den ſeit langen Jahren vernachläſſigten Garten wieder in Ordnung ſetzte (he occupied himself with it that he put again in order the for many years neglected garden). Usually the Infinitive stands at the end of such a phrase, and the words dependent on it are placed before it.

When two or three Infinitives come together, that one is placed last on which the others depend. Thus, er hat mich nicht gehen laſſen wollen, *he did not want to let me go.*

The Participles are really adjectives, and their uses are, properly speaking, adjectival.

The Present Participle is active in meaning, and is used adjectivally.

Thus, ein lachendes Kind, *a laughing child ;* die kommende Woche, *the coming week.*

In the same way as an ordinary adjective, the Present Participle can be used as a noun. Thus, der Reiſende, *the traveller* (the travelling one).

The Present Participle can be modified by other words. Thus, das laut lachende Kind, *the loudly laughing child.*

Occasionally the Present Participle is used in a Passive sense. Thus, eine melkende Kuh, *a milking cow*, i.e. a cow that is milked.

Such an expression as eine ſchwindelnde Höhe, *a giddy height*, may be compared to similar uses of the participle in English, e.g. sleeping sickness.

The Past Participle of transitive verbs is merely passive in meaning, and does not necessarily refer to past time. Thus, das gelobte Land, *the promised land ;* die geliebte Mutter, *the beloved mother.*

The Past Participle of intransitive verbs is, as a rule, active in meaning, and is only used to form the Compound tenses of the verb. But those intransitive verbs which are

conjugated with ſein instead of haben, can have their Past Participle used adjectivally. This use always refers definitely to the past. Thus, ein weit gereiſter Mann, *a widely travelled man*, i.e. a man who has travelled far.

In a few special cases the Past Participle of transitive verbs is used in an active sense. Thus, ein ausgedienter Soldat, *a soldier who has served his time*: ein abgeblühter Baum, *a tree which has finished flowering*.

Many words which have the form of Past Participles are used as ordinary adjectives.

The commonest are the following: gelehrt, *learned* (lehren, *to teach*), bekannt, *known* (bekennen, *to confess*), erhaben, *lofty* (erheben, *to raise*, Past Part. erhoben), gediegen, *solid, sterling* (gedeihen, *to thrive*), gelaſſen, *cool* (laſſen, *to leave*); geſcheit, *clever*, verſchieden, *different*, verlegen, *embarrassed*, bejahrt, *aged*.

Some of the above have the meaning of a Present Participle, though they have the form of a Past Participle. Thus, verſchwiegen, *silent, discreet*, beſorgt, *anxious*.

The Future Passive Participle is only formed from transitive verbs, and is always used attributively. Thus, eine nicht zu unterſchätzende Gefahr, *a danger that must not be underrated*, i.e. (a not to be underrated danger).

The Present Participle is used only attributively, with the exception of such examples as have assumed the value of adjectives pure and simple, and have completely lost their participial character. There are a considerable number of these, and they are also used predicatively like ordinary adjectives: Some of the commonest are: reizend, *charming*, belebend, *stimulating*, bedeutend, *important*, and so on. Thus, ſie iſt reizend, *she is charming*.

With the exception of the Past Participles of intransitive verbs which are conjugated with haben, all Past Participles can be used both attributively and predicatively. Like other adjectives, they may also be used as nouns. Thus, er ſuchte vergebens die Verlorenen, *he sought the lost ones in vain*.

The Participles are rarely used adverbially, except in so far as they have become pure adjectives. Thus, ein entzückend ſchönes Bild, *a ravishingly beautiful picture*.

Both the Present and the Past Participles are often used as adjuncts placed after the noun. They may be used either alone or with modifying words. Thus, ſie ſtand händeringend vor der Tür, *she stood before the door wringing her hands*: er ging gebückt von dannen, *he went thence bowed down*.

Such Participles and participial phrases can in German only be used where we could use in their place an Adjective Clause. In English we often use participial constructions in place of Adverbial Clauses; in German a proper adverbial clause must then be used. Thus, *coming home late last night, I found the house on fire*, als ich geſtern Abend ſpät nach Hauſe kam, fand ich das Haus in Brand.

The Past Participle is used in the sense of a Present Participle in certain constructions with verbs of motion. Thus, es kommt ein Vogel geflogen, *a bird comes flying*; das Kind kam angeſprungen, *the child came jumping along*.

After verbs of calling the Past Participle is sometimes used in the sense of an Infinitive. Thus, das nennt er gut gearbeitet, or das nennt er gut arbeiten, *he calls that working well*.

VOCABULARY

welken, w., *to fade, wither*.
Wieſe, w.f., *meadow*.
Nachbar, w.m., *neighbour*.
Haupt, *chief*.
ſchütteln, w., *to shake*.
vorwärts, *forward*.
klirren, w., *to clink, rattle*.
Schnitter, s.m.1, *reaper*.
unermüdlich, *tireless, untiring*.
fort'ſtreichen, s., *to sweep onward*.
hügellos, *flat*.
Zug, s.m.2, *chain line*.
Bach, s.m.2, *brook*.
ein'faſſen, w., *to enclose, edge*.
bilden, *to form*.
üppig, *luxuriant*.
begrenzen, w., *to limit, bound*.
Glocke, w.f., *bell*.
Kirche, w.f., *church*.
Mittelpunkt, s.m.2, *centre*.
braun, *brown*.
Dach, s.n.3, *roof*.
umgeben, s., *to surround*.
ſtattlich, *stately*.
Gebäude, s.n.2, *building*.
erkennen, w., an, *recognise by*.
wollig, *woolly*.
mähen, w., *to mow*.
Gras, s.n.3, *grass*.
Station', w.f., *station*.
mit'nehmen, s., *to take with* (one).
rüſtig, *vigorous*.
lachen, w., *to laugh*.
Senſe, w.f., *scythe*.
Wetzſtein, s.m.2, *whetstone, hone*.
Lerche, w.f., *lark*.
Landſchaft, w.f., *landscape*.
Horizont', s.m.2, *horizon*.
Gebirge, s.n.1, *mountain range*.
Erle, w.f., *alder*.
durchrinnen, s., *to flow through*.
Wieſental, s.n.3, *valley with meadows*.
Getreide, s.n., *corn*.
hell, *clear, distinct*.
Turm, s.m.2, *tower, steeple*.
Boden, s.m.1, *ground*.
Gruppe, w.f., *group*.
rot, *red*.
Gehölz, s.n.2, *wood, trees*.
Dorf, s.n.3, *village*.
Allee, w.f., *avenue*.
Ritterſitz, s.m.2, *manor house*.
Schäferhund, s.m.2, *sheepdog*.
Herde, w.f., *flock, herd*.

Exercise 61

Schon welkte das friſch gemähte Wieſengras in der Mittagsſonne, als Anton dem Nachbar[1] aus Oſtrau, der ihn bis zur letzten Station von der Hauptſtadt mitgenommen hatte, die Hand ſchüttelte und dann rüſtig auf der Landſtraße vorwärts ſchritt. Es war ein lachender Sommertag, auf den Wieſen klirrte die Senſe des Schnitters am Wetzſtein und oben in der Luft ſang

die unermüdliche Lerche. Vor dem Wanderer ſtrich die Landſchaft in hügelloſer[2] Ebene fort, am Horizont hinter ihm erhob ſich der blaue Zug des Gebirges. Kleine Bäche, von Erlen[3] und Weidengruppen eingefaßt, durchrannen luſtig die Landſchaft, jeder Bach bildete ein Wieſental, das auf beiden Seiten von üppigen Getreidefeldern begrenzt wurde. Von allen Seiten ſtiegen die hellen[4] Glockentürme der Kirchen aus dem Boden auf, jeder als Mittelpunkt einer Gruppe von braunen und roten Dächern, die mit einem Kranz von Gehölz umgeben waren. Bei vielen Dörfern konnte man an der ſtattlichen Baumallee und dem Dach eines großen Gebäudes den Ritterſitz erkennen, welcher neben den Dörfern lag, wie der Schäferhund neben der wolligen Herde.

G. von Freytag.

NOTES:—

(1) dem Nachbar: the usual construction of the dative of the person followed by the definite article where we use a possessive. (2) hügellos, literally, without hills. (3) Erlen und Weidengruppen: when the second member of two compounds is the same, and the words are used close together, it is usual to affix the second member to the second word only, and leave it to be understood with the first. Here Gruppen must be understood with Erlen, i.e. groups of alder and willow. (4) hell: this word is generally used in the sense of bright, with reference to colour, light, or sound. Here the writer is probably thinking of the clear sound of the bells.

VOCABULARY

remarkable, merkwürdig.
release, Befreiung, w.f.
devotion, Aufopferung, w.f.
nearly, beinahe.
fortress, Feſtung.
government, Regierung, w.f.
province, Provinz, w.f.
imprisonment, Gefängniß, s.n.2.
share, teilen, w.
greatly, in großem Maße.
solitude, Einſamkeit, w.f.
prosecute, weiterführen, w. sep.
chest, Kiſte, w.f.
sentries, Wache, w.f.
strictness, Strenge, w.f.
amongst, unter.
at length, ſchließlich.
give up, unterlaſſen, s. insep.
instance, Fall, s.m.2.
husband, Gatte, w.m.
celebrated, berühmt.
strong, ſtark.
condemn, verurteilen, w.
united, vereinigt.
perpetual, lebenslänglich.
to be allowed, dürfen.
cell, Zelle, w.f.
relieve, erleichtern, w.
permit, erlauben, w., gov. dat.
require, brauchen.
study, Studium, s.n., pl. Studien.
hold, unterbringen, w. sep.
examine, unterſuchen, w. insep.
contain, enthalten, s.
linen, Leinen, s.n.1.
search, Nachforſchung, w.f.
pass in and out, ein und ausgehen, s.

Exercise 62

The most remarkable instance of the release of a husband through the devotion of his wife was that of the celebrated Grotius. He had lain for[1] nearly twenty months in the strong fortress of[2] Loewenstein, near[3] Gorcum, having[4] been condemned by the government of the United Provinces to perpetual imprisonment. His wife, having been allowed[5] to share his cell, greatly relieved[6] his solitude. She was permitted[7] to go into the town twice a[8] week, and[9] bring her husband books, of which he required a large number to enable[10] him to prosecute his studies. At length a large chest was required[11] to hold them. This the sentries[12] at first examined with great strictness; but finding that it only contained books (amongst others Arminian[13] books) and linen, they at length gave up the search, and it[14] was allowed to pass out and in as a matter of course.

S. Smiles.

NOTES:—

(1) Omit *for*. (2) Omit *of*. (3) *Near*, in this sense bei. (4) *Having . . . condemned*, say *as* (da) *he had been condemned by* (von). (5) *Having been allowed*, etc., say, *was allowed . . . cell and greatly*, etc. (6) *Relieved*, say, *relieved to him the solitude*. (7) *She was permitted*, say, *it was permitted* (erlaubt) *to her*. As erlauben governs the dative, it can be used passively only in this impersonal construction. (8) *A week*—the Germans use the definite article. (9) *And bring*, say, *in order to bring*. (10) *To enable him to*, say, *in order to*. (11) *Was required*, war nötig (necessary). (12) *Sentries*—Wache is used in the singular. (13) *Arminian*, arminiſch. (14) *It was . . . course*, man hielt es für ſelbſtverſtändlich dieſelbe ein und ausgehen zu laſſen.

Key to Exercise 59

THE MESSENGERS OF DEATH (*Continued*)

"All right," said the youth, "it is at any rate (always) an advantage that I know when you come, and am at least safe from you till then (so long)," he went on, was merry, and of good cheer and lived recklessly. However, youth and health did not last long; there came sickness and pains which plagued him. "I shall not die," said he to himself, "for Death will first send his messengers; I only wish the bad days of sickness were well over." As soon as he felt well, he began to live a life of pleasure again. Then one day someone tapped him on the shoulder, and when he looked round, Death stood behind him and said: "Follow me. The hour of parting from the world has come." "What!" cried the man. "Are you going to break your word? Did you not promise me that, before you came yourself, you would send your messengers? I have not seen any." "Silence," replied Death; "did I not send you one messenger after another? Did not the fever come, strike you, and overthrow you? Did not dizziness daze your head? Did not the gout nip you in all your limbs? Did you not have buzzing in your ears? Did not toothache gnaw at your jaws (cheeks)? Did it not grow dark before your eyes? Above all that, did not my very own brother, Sleep, remind you of me every evening? Did you not lie in the night as though you were already dead?" The man did not know what to reply; he resigned himself to his fate, and went away with Death.

Key to Exercise 60

Aber da ſie nur einer nach dem andern durch die Furte gehen konnten, tödtete Bruce, der hoch über ihnen auf dem Ufer wo ſie ans Land ſteigen ſollten ſtand, den Vorderſten mit einem Stoß ſeines langen Speers, und mit einem zweiten Stoß erſtach er das Pferd. In der Verwirrung wurden fünf bis ſechs von den Feinden erſchlagen oder, von der Strömung fortgeriſſen ertranken ſie. Die andern wichen entſetzt zurück. Aber als die Männer von Galloway wieder hinblickten und ſahen daß nur ein Mann ihnen gegenüber ſtand, während ihrer ſo viele waren, riefen ſie daß ihre Ehre auf immer verloren gehen würde wenn ſie nicht den Übergang erzwängen, und ermutigten ſich gegenſeitig, mit lautem Geſchrei, durchzuwaten und ihn anzufallen. Aber jetzt kamen die Soldaten des Königs ihm zur Hülfe, und die Männer von Galloway zogen ſich zurück und gaben ihr Unternehmen auf.

M. A. L.

RUSSIAN.—XVI

Numbers

177. *Declension of Cardinal Numbers.*

	Singular		
	Masculine	*Feminine*	*Neuter*
Nom.	Оди́нъ	Одна́	Одно́
Gen.	Одного́	Одно́й	Одного́
Dat.	Одному́	Одно́й	Одному́
Acc.	As *Nom.* or *Gen.*	Одну́	Одно́
Inst.	Одни́мъ	Одно́й	Одни́мъ
Prep.	Объ одно́мъ	Объ одно́й	Объ одномъ
	Plural		
Nom.	Одни́	Одне́	Одни́
Gen.	Одни́хъ	Одне́хъ	Одни́хъ
Dat.	Одни́мъ	Одне́мъ	Одни́мъ
Acc.	Animate as *Gen.*,	Inanimate as *Nom.*	
Inst.	Одни́ми	Одне́ми	Одни́ми
Prep.	Объ одни́хъ	Объ одне́хъ	Объ одни́хъ

181. Like Пятьдеся́тъ are declined the following: Шестьдеся́тъ, 60, Се́мьдесятъ, 70, Во́семьдесятъ, 80 (Gen. and Dat. Восьми́десяти, Inst. Восьмьюдесятью).

182. Like Две́сти, 200, are declined Три́ста, 300, and Четы́реста, 400.

183. Like Пятьсо́тъ, 500, are declined the following: Шестьсо́тъ, 600, Семьсо́тъ, 700, Восемьсо́тъ, 800, Девятьсо́тъ, 900.

184. The number Ты́сяча, *thousand*, is declined in singular and plural like any other noun, feminine, with ending -ча.

185. The number Милліо́нъ, *a million*, is declined in singular and plural like any other masculine noun with the same hard ending.

186. The fractions: полови́на, *a half*, треть, *a third*, че́тверть, *a quarter*, are declined in singular and plural like feminine nouns.

178. *Table O.—Declension of Cardinal Numbers.*

	Два, m. / Двѣ, f. / Два, n. *Two*	Три *Three*	Четы́ре *Four*	Пять *Five*	Со́рокъ *Forty*	Пятьдеся́тъ *Fifty*
Nom.	As above, depending on Gender.	Три	Четы́ре	Пять	Со́рокъ	Пятьдеся́тъ
Gen.	Двухъ	Трёхъ	Четырёхъ	Пяти́	Сорока́	Пяти́десяти
Dat.	Двумъ	Трёмъ	Четырёмъ	Пяти́	Сорока́	Пяти́десяти
Acc.	Animate as *Gen.*,	Inanimate as *Nom.*		Пять	Со́рокъ	Пятьдеся́тъ
Instr.	Двумя́	Тремя́	Четырьмя́	Пятью́	Сорока́	Пятью́десятью́
Prep.	О двухъ	О трёхъ	О четырёхъ	О пяти́	О сорока́	О пяти́десяти.

179. *Table O (Continued).*

	Девяно́сто *Ninety*	Сто *Hundred*	Две́сти *Two hundred*	Пятьсо́тъ *Five hundred*
Nom.	Девяно́сто	Сто	Две́сти	Пятьсо́тъ
Gen.	Девяно́ста	Ста	Двухъсо́тъ	Пяти́сотъ
Dat.	Девяно́ста	Ста	Двумъста́мъ	Пяти́стамъ
Acc.	Девяно́сто	Сто	Две́сти	Пятьсо́тъ
Inst.	Девяно́ста	Ста	Двумяста́ми	Пятью́стами
Prep.	О девяно́ста	О ста	О двухъста́хъ	О пяти́стахъ

180. Like пять are declined the following: Шесть, 6, Семь, 7, Во́семь, 8 (Gen. and Dat. Восьми́, Inst. Восьмью́, Prep. О восьми́), Де́вять, 9, Де́сять, 10, Оди́надцать, 11, Две́надцать, 12, Трина́дцать, 13, Четы́рнадцать, 14, Пятна́дцать, 15, Шестна́дцать, 16, Семна́дцать, 17, Восемна́дцать, 18, Девятна́дцать, 19, Два́дцать, 20, Три́дцать, 30.

187. In compound Cardinal numbers every figure is declined separately.

Examples

Я на́чалъ мое́ де́ло то́лько двумяста́ми тридцатью́ семью́ рубля́ми. *I (have) started my business with only 237 roubles.*

188. Ordinal Numbers are treated like Adjectives according to their endings and genders.

189. In compound Ordinal numbers only the last figure is declined, the preceding remaining unchanged.

Examples

Ру́сское госуда́рство бы́ло осно́вано въ восемьсо́тъ шестьдеся́тъ второ́мъ году́. *The Russian State was established in the year 862.*

190. *Table P.—Declension of Collective Numbers.*

	О́ба *both* m. and n.	О́бѣ *both* fem.	Полтора́ *one and a half*	Полторы́ *one and a half*	Полуторы́ *ones and halves* plural
			m. and n.	fem.	all genders.
Nom.	О́ба	О́бѣ	Полтора́	Полторы́	Полуторы́
Gen.	Обо́ихъ	Обе́ихъ	Полутора́	Полуторы́	Полуторы́хъ
Dat.	Обо́имъ	Обе́имъ	Полтору́	Полторе́	Полуторы́мъ
Acc.	*Gen.* or *Nom.*		Полтора́	Полторы́	Полуторы́
Inst.	Обо́ими	Обе́ими	Полуторы́мъ	Полуторо́ю	Полуторы́ми
Prep.	Объ обо́ихъ	Объ обе́ихъ	О полторе́	О полторе́	О полуторы́хъ

191. Nouns coming after the Nominative of о́ба, о́бѣ, полтора́, полтори́ are expressed in Genitive Singular. In all other cases the nouns following the collective numbers are expressed in the plural and in the same cases as the preceding numbers.

192. Adjectives coming after the Nominative of о́ба, о́бѣ, полтора́, полтори́, are expressed in the Nominative Plural. In all other cases they coincide with the preceding numbers.

Examples

О́ба бра́та уча́ствуютъ въ дѣлѣ.	*Both brothers participate in the business.*
Дѣлай дѣло обѣ́ими рука́ми.	*Do the work with both hands.*
О́бѣ но́выя зада́чи не рѣши́мы.	*The new problems are both without solution.*
Полтора́ арши́на сукна́ недоста́точно.	*One and a half arshins of cloth are insufficient.*
Да́йте мнѣ полтори́ дю́жины круже́съ.	*Give me one and a half dozen laces.*

193. *Table P.—Continued.*

	Дво́е, *Two*	Тро́е, *Three*	Че́тверо, *Four*
Nom.	Дво́е	Тро́е	Че́тверо
Gen.	Двои́хъ	Трои́хъ	Четверы́хъ
Dat.	Двои́мъ	Трои́мъ	Четверы́мъ
Acc.	Like *Gen.* or *Nom.*		*Gen.* or *Nom.*
Inst.	Двои́ми	Трои́ми	Четверы́ми
Prep.	О двои́хъ	О трои́хъ	О четверы́хъ.

194. Like че́тверо are declined: пя́теро, *five*; ше́стеро, *six*, семе́ро, *seven*, восьме́ро, *eight*, девятеро, *nine*, десятеро, *ten*.

195. Nouns and Adjectives coming after the Nominative (or the Accusative if it is identical with the Nominative) of any of the numbers given in rules 193 and 194 are expressed in Genitive Plural; otherwise the cases of the Nouns and the Adjectives agree with those of the Numbers.

Examples

Дво́е больши́хъ тюко́въ поступи́ло для насъ сего́дня изъ Нью-Іо́рка.

Two (a pair, a couple of) big bales have arrived for us to-day from New York.

Че́тверо недово́льныхъ прика́щиковъ вчера́ оста́вили на́шу фи́рму.

Four (a clique, a gang of four) dissatisfied employees have left yesterday our firm.

197. When a Noun is combined with the particle „пол," *half*, its Nominative Singular assumes the ending of the Genitive Singular, as exemplified below:

Мѣсяцъ, *a month.*	Полмѣсяца, *half a month.*
Годъ, *a year.*	Полго́да, *half a year.*
Пудъ, *a pood* (36½ *lb.*).	Полпу́да, *half a pood.*
Фунтъ, *a pound.*	Полфу́нта, *half a pound.*

198. In all the cases where any declinable word is combined with the particle „пол," this particle remains unchanged only in Nominative and Accusative Singular, otherwise it is changed to „полу" for all the cases of Singular and Plural.

Examples

Я приду́ къ Вамъ въ по́лдень.	*I shall come to you at noon.*
Конча́йте рабо́ту до полу́дня.	*Finish the work before noon.*
Отпра́вьте това́ръ по полу́дню.	*Send off the goods in the afternoon.*

The Pronoun

199. *Table R.—Declension of Personal Pronouns.*

Singular

	Я	Ты	Онъ	Она́	Оно́
	I	*Thou*	*He*	*She*	*It*
Nom.	Я	Ты	Онъ	Она́	Оно́
Gen.	Меня́	Тебя́	Его́	Ея́	Его́
Dat.	Мнѣ	Тебѣ́	Ему́	Ей	Ему́
Acc.	Меня́	Тебя́	Его́	Ёе	Его́
Inst.	Мно́ю	Тобо́ю	Имъ	Е́ю	Имъ
Prep.	Обо мнѣ	О тебѣ́	О нёмъ	О нёй	О нёмъ

Plural

Nom.	Мы	Вы	Они́	Онѣ́	Они́
Gen.	Насъ	Васъ	Ихъ	Ихъ	Ихъ
Dat.	Намъ	Вамъ	Имъ	Имъ	Имъ
Acc.	Насъ	Васъ	Ихъ	Ихъ	Ихъ
Inst.	На́ми	Ва́ми	И́ми	И́ми	И́ми
Prep.	О насъ	О васъ	О нихъ	О нихъ	О нихъ

200. For the sake of euphony the letter "н" is appended to any Personal Pronoun beginning with a vowel in any of the cases of both numbers, except Nominative Singular and Plural, whenever the Personal Pronoun is preceded by a preposition.

Examples

Безъ него́, *without him.*	Отъ нея́, *from her.*
Къ нему́, *to him.*	Съ не́ю, *with her.*
Съ нимъ, *with him.*	

196. *Table Q.—Declension of Numbers in Combination with other Parts of Speech.*

	По́лдень, m. *Mid-day*	По́лночь, f. *Midnight*	Полчаса́ *half an hour*	Полусыро́й-а́я-о́е *Half raw*
Nom.	По́лдень	По́лночь	Полчаса́	Полусыро́й-а́я-о́е
Gen.	Полу́дня	Полу́ночи	Получаса́	Полусыро́го-о́й-о́го
Dat.	Полу́дню	Полу́ночи	Получа́су	Полусыро́му-о́й-му
Acc.	По́лдень	По́лночь	Полчаса́	Полусыро́й-у́ю-ое
Inst.	Полу́днемъ	Полу́ночью	Получа́сомъ	Полусыры́мъ-о́й-ы́мъ
Prep.	О полу́днѣ	О полу́ночи	О получа́сѣ	О полусыро́мъ-о́й-мъ

201. The reflective Pronoun "себя́," *oneself* or *one's self*, is declined as follows :—

Singular and Plural

Nom.	*Gen.*	*Dat.*	*Acc.*	*Inst.*	*Prep.*
—	Себя́	Себѣ́	Себя́	Собо́ю	О себѣ́

202. This reflective Pronoun may be invariably used in conjunction with any Personal Pronoun.

Examples

Мы себя́ не щади́мъ — *We do not spare ourselves.*

Они́ поко́нчили ме́жду собо́ю. — *They have settled between themselves.*

203. *Table S.—Declension of all other Pronouns.*

I.

	Sing.			*Plur.*
	Мой	Моя́	Моё	Мои́
	my	*my*	*my*	*my*
	Masc.	*Fem.*	*Neuter*	*All Genders*
Nom.	Мой	Моя́	Моё	Мои́
Gen.	Моего́	Мое́й	Моего́	Мои́хъ
Dat.	Моему́	Мое́й	Моему́	Мои́мъ
Acc.	*Nom.* or *Gen.*	Мою́	Моё	*Nom.* or *Gen.*
Inst.	Мои́мъ	Мое́ю	Мои́мъ	Мои́ми
Prep.	О моёмъ	О мое́й	О моёмъ	О мои́хъ

II.

	Sing.			*Plur.*
	Чей	Чья	Чьё	Чьи
	whose	*whose*	*whose*	*whose*
	Masc.	*Fem.*	*Neuter*	*All Genders*
Nom.	Чей	Чья	Чьё	Чьи
Gen.	Чьего́	Чьей	Чьего́	Чьихъ
Dat.	Чьему́	Чьей	Чьему́	Чьимъ
Acc.	*Nom.* or *Gen.*	Чью	Чьё	*Nom.* or *Gen.*
Inst.	Чьимъ	Чье́ю	Чьимъ	Чьи́ми
Prep.	О чьёмъ	О чьей	О чьёмъ	О чьихъ

III.

	Sing.			*Plur.*
	Э́тотъ	Э́та	Э́то	Э́ти
	this	*this*	*this*	*these*
	Masc.	*Fem.*	*Neuter*	*All Genders*
Nom.	Э́тотъ	Э́та	Э́то	Э́ти
Gen.	Э́того	Э́той	Э́того	Э́тихъ
Dat.	Э́тому	Э́той	Э́тому	Э́тимъ
Acc.	*Nom.* or *Gen.*	Э́ту	Э́то	*Nom.* or *Gen.*
Inst.	Э́тимъ	Э́той	Э́тимъ	Э́тими
Prep.	Объ э́томъ	Объ э́той	Объ э́томъ	Объ э́тихъ

IV.

	Sing.			*Plur.*
	Тотъ	Та	То	Тѣ
	that	*that*	*that*	*those*
	Masc.	*Fem.*	*Neuter*	*All Genders*
Nom.	Тотъ	Та	То	Тѣ
Gen.	Того́	Той	Того́	Тѣхъ
Dat.	Тому́	Той	Тому́	Тѣмъ
Acc.	*Nom.* or *Gen.*	Ту	То	*Nom.* or *Gen.*
Inst.	Тѣмъ	То́ю	Тѣмъ	Тѣми
Prep.	О томъ	О той	О томъ	О тѣхъ

V.

	Sing.			*Plur.*
	Самъ	Сама́	Само́	Са́ми
	alone, self	*self*	*self*	*alone, selves*
	Masc.	*Fem.*	*Neuter*	*All Genders*
Nom.	Самъ	Сама́	Само́	Са́ми
Gen.	Самого́	Само́й	Самого́	Са́михъ
Dat.	Самому́	Само́й	Самому́	Са́мимъ
Acc.	Самого́	Само́	Само́	Са́михъ
Inst.	Сами́мъ	Само́ю	Сами́мъ	Сами́ми
Prep.	О само́мъ	О само́й	О само́мъ	О са́михъ

VI.

	Sing.			*Plur.*
	Нашъ	На́ша	На́ше	На́ши
	our	*our*	*our*	*our*
	Masc.	*Fem.*	*Neuter*	*All Genders*
Nom.	Нашъ	На́ша	На́ше	На́ши
Gen.	На́шего	На́шей	На́шего	На́шихъ
Dat.	На́шему	На́шей	На́шему	На́шимъ
Acc.	*Nom.* or *Gen.*	На́шу	На́ше	*Nom.* or *Gen.*
Inst.	На́шимъ	На́шей	На́шимъ	На́шими
Prep.	О на́шемъ	О на́шей	О на́шемъ	О на́шихъ

VII.

	Sing.			*Plur.*
	Весь	Вся	Всё	Всѣ
	all	*all*	*all*	*all*
	Masc.	*Fem.*	*Neuter*	*All Genders*
Nom.	Весь	Вся	Всё	Всѣ
Gen.	Всего́	Всей	Всего́	Всѣхъ
Dat.	Всему́	Всей	Всему́	Всѣмъ
Acc.	*Nom.* or *Gen.*	Всю	Всё	*Nom.* or *Gen.*
Inst.	Всѣмъ	Все́ю, всей	Всѣмъ	Всѣми
Prep.	О всёмъ	О всей	О всёмъ	О всѣхъ

VIII.

	Кто	Что	Ско́лько
	who	*what*	*how much, how many*
Nom.	Кто	Что	Ско́лько
Gen.	Кого́	Чего́	Ско́лькихъ
Dat.	Кому́	Чему́	Ско́лькимъ
Acc.	Кого́	Что	Ско́лько
Inst.	Кѣмъ	Чѣмъ	Ско́лькими
Prep.	О комъ	О чёмъ	О ско́лькихъ

204. Like мой are declined твой, *thy*, свой, *one's*, in accordance with the numbers and genders.

205. Like чей are declined сей, masc., сія́, fem., сіе́, neut., *this;* and сій, all Gen., *these*, omitting the "ь" everywhere. In Accusative feminine Singular, it has сію́.

206. Like нашъ is declined Вашъ, *your.*

207. Like кто is declined никто́, *nobody.*

208. Like что is declined ничто́, *nothing.*

209. Like сколько are declined нѣсколько, *a little, several,* сто́лько, *so much* or *so many.*

210. The Pronouns ско́лько, нѣсколько, сто́лько govern the Genitive Singular of Nouns and Adjectives when denoting a part of a whole; otherwise they demand

(in the Nominative case only) the Genitive Plural.

Examples

Ско́лько у Васъ бума́ги ?	*How much paper have you ?*
Ско́лько у Васъ бума́гъ ?	*How many papers (documents) have you ?*
У меня́ то́лько сто́лько ча́ю.	*I have only got so much (of) tea.*
У него́ сто́лько ча́евъ.	*He has so many sorts of tea.*
Да́йте мнѣ нѣсколько со́ли.	*Give me a bit of salt.*
Онъ смѣша́лъ нѣсколько соле́й.	*He has mixed together several salts.*

211. The following Pronouns: Са́мый-ая-ое, *the very* (Superlative); ка́ждый-ая-ое, *each, every;* вся́кій-ая-ое, *every;* кото́рый-ая-ое, *which;* како́й-ая-ое, *which*, are declined like Adjectives.

VOCABULARY

NOTE.—For the remaining exercises of this Course, which will be of a more general character, the student is recommended to make ample use of his Russian dictionary.

Выпи́сывать пря́мо (Reit.), *to order direct.*
Во пе́рвыхъ, *first of all, in the first place.*
По́шлины, *the duty* (custom-house).
Слу́чай, *case.*
Сли́шкомъ, *too.*
Затѣмъ, *then.*
Да́льность разстоя́нія, *the great distance.*
Мѣшать (Imp.), with Dative, *to hinder.*
Тѣсное сближе́ніе, *close acquaintance.*
Недоста́точно, *not enough, insufficient.*
Назна́чить (P.), *to appoint.*
Вояжёръ, *commercial traveller.*
Періоди́чески, *periodically.*
По́льзованіе перево́дчиками, *the use of, the resorting to interpreters.*
Утоми́тельно, *wearisome.*
Пря́мо невы́годно, *downright unprofitable.*
Препя́тствіе, *obstacle.*
Вско́рѣ, *soon.*
Устраненó, *removed.*
Подви́нуть (P.), *to advance, move.*
Ánгло-Ру́сскія сноше́нія, *the Anglo-Russian relations.*
Впередъ, *further.*
Разъ, *once.*
Согласи́ться (P.), *to agree, consent.*
Подходя́щій, *suitable.*
Ры́нокъ, *market.*
Крайнѣйшія, *the lowest.*
Допуска́ть (Imp.), *to grant.*
Коне́чно, *certainly.*
Преиму́щество, *preference.*
По́ле би́твы, *battlefield.*
Та́кже, *also.*
Предпрія́тіе, *undertaking.*
Совреме́нная, *modern.*
Гига́нтская, *gigantic.*
Международная торго́вля, *international commerce.*
Созда́ть (P.), *to create.*
Трусъ, *a poltroon, coward.*
Пра́вда, *it is true.*
Арте́рія, *artery.*
Тогда́, *then.*
Осно́ванъ, *based.*
Благосостоя́ніе, *well-being, prosperity, good standing.*
Благонамѣренность, *good intentions, probity.*
Всё таки́, *still, yet, none the less, nevertheless.*
Торгу́ющія сто́роны, *trading parties.*
Вверя́ть (Imp.), *to entrust.*
Чужія ру́ки, *foreign hands.*
Часть, *a part.*
Народныя сбереже́нія, *the national savings.*
Йбо, *for, because.*
Атомъ, *the atom.*
Отпу́щенный, *disposed of.*
Давно́, *long ago.*
По́лностью, *fully, in full.*
Опла́ченъ, *is paid for.*
Со́бственный капита́лъ, *one's own capital.*
Трудъ, *toil.*
Повторя́ть (Imp.), *to repeat.*
Бредъ, *delirium.*
Извѣстный, *certain, some.*
Писе́цъ, *scribbler, writer.*
По наслы́шкѣ, *from hearsay.*
Профа́нъ, *uninformed (illiterate) person.*
Фантазёръ, *visionary.*
Проходи́мецъ, *swindler, rogue.*
Не смотря́, *notwithstanding.*
Бди́тельность, *vigilance.*
Зако́нъ, *law.*
Успѣва́ть (Imp.), *to manage.*
Жить (Imp.), *to live.*
Чи́стый грабёжъ, *sheer robbery.*
Ма́ска, *the disguise.*
Приме́ръ, *an instance, example.*
Довѣрчивый, *credulous.*
Си́льно, *heavily.*
Пострада́ть (P.), *to suffer.*
На́глый грабёжъ, *impudent robbery.*
Банкро́тство, *bankruptcy.*
Случа́ться (Imp.), *to happen.*
Страна́, *country.*
Торго́вый міръ, *the commercial world.*
Воздéрживаться (Reiterative), *to refrain, stop.*
Предоставле́ніе, *granting.*
Хра́брость, *bravery.*
Необходи́ма, *is indispensable.*
Брать уро́ковъ, *take lessons.*
Жела́тельно, *desirable.*
О́бщій, *common, general, joint.*
Дѣйстви́тельный, *real.*
О́пытный, *experienced.*
Коммерса́нтъ, *merchant.*
Банки́ръ, *banker.*
Промы́шленникъ, *manufacturer.*
Конферéнція, *conference.*
Соста́вить планъ (P.), *to draw up, form a plan.*
По коему́, *in accordance with which.*
Дѣловы́е лю́ди, *business men.*
Взаи́мно содѣйствовать (Imp.), *to contribute, co-operate mutually.*
Прогре́ссъ, *progress.*
Госуда́рство, *the State, empire, kingdom.*
Фа́брики и заво́ды, *factories and mills.*
Тру́женникъ, *toiler.*
Верну́ть въ уро́чный часъ (P.), *to return at the fixed hour.*

Exercise 28

1. Вы меня́ спра́шиваете почему́ мы ма́ло поку́па́емъ англíйскаго това́ра ?

2. Мы покупа́емъ англíйскаго това́ра дово́льно мно́го, но мы его́ получа́емъ чрезъ вторы́я ру́ки.

3. Почему́ не выпи́сываете пря́мо изъ Áнглiи ?

4. Во пе́рвыхъ, по́шлины во мно́гихъ слу́чаяхъ сли́шкомъ высоки́.

5. Затѣмъ да́льность разстоя́нія мно́го мѣша́етъ на́шему бо́лѣе тѣсному сближе́нію.

6. Но мы имѣемъ въ Россíи представи́телей.

7. Число́ Ва́шихъ представи́телей весьма́ недоста́точно. Вы бы назна́чили по а́генту въ ка́ждомъ большо́мъ го́родѣ.

8. За то мы періоди́чески посыла́емъ Вамъ на́шихъ вояжёровъ.

9. Оно́ бы́ло бы хорошо́, е́сли бы Ва́ши вояжёры хорошо́ зна́ли Ру́сскій язы́къ, по по́льзованіе перево́дчиками утоми́тельно и пря́мо невы́годно.

10. Это препя́тствіе бу́детъ вско́рѣ устранено́. Подви́нетъ ли оно́ Áнгло-Ру́сскія сноше́нія впередъ ?

Exercise 29

1. As soon as you agree to give us the goods which suit our market, to charge us the lowest prices and grant long credits, we shall certainly give you the preference.

2. And do you know that there are in Russia such swindlers, who, notwithstanding the vigilance of your laws, manage, however, to live by sheer robbery under the disguise of credit ?

3. I know of several instances, where credulous Englishmen severely suffered through these impudent robberies.

4. Bankruptcies happen in every country every day, and still the commercial world does not refrain from granting fresh credits.

5. Bravery is indispensable not only on the battlefield, but also in commercial undertakings. Modern gigantic international commerce has not been created by cowards.

6. It is true. Credit is the artery of trade, but only when it is based on the good standing (prosperity) and probity of both trading parties. A. C.

GREEK.—V

Irregular Declensions

THERE are some nouns of the third declension that cannot be classified, and the differential points of these must therefore be given separately. They include :—

(1) ἄναξ (ὁ), ἄνακτος, voc., ἄναξ (poetic, ἄνα), *king.*
(2) γάλα (τό), γάλακτος, *milk.*
(3) γόνυ (τό), γόνατος, *knee.*
(4) γυνή (ἡ), *married woman, wife*; γυναικ-ός, γυναικ-ί, γυναῖκ-α, γύναι; pl. γυναῖκες, γυναικῶν, γυναιξί(ν), γυναῖκας.
(5) δόρυ (τό), δόρατος, δόρατι or δορί, Ion. and poet., δούρατος or δουρός, δουρί, δορί or δόρει; pl. δοῦρα, δούρων, δούρεσσι(ν).
(6) Ζεύς, Zeus (Jupiter); Διός, Διί, Δία, Ζεῦ; Ion. and poet. Ζηνός, Ζηνί, Ζῆνα.
(7) θρίξ (ἡ), *hair*; τριχός, τριχί, etc.; dat. pl., θριξί.
(8) κλείς (ἡ), *key*; κλειδός, κλειδί, κλεῖν; pl. nom. and acc. κλεῖς (also κλεῖδες), κλεῖδας, κλεισί(ν).
(9) κύων (ὁ, ἡ), *dog*; voc. κύον, κυν-ός, κυν-ί, κύν-α; pl. κύνες, κυνῶν, κυσί (ν), κύνας.
(10) μάρτυς (ὁ), *witness*; μάρτυρος, μάρτυρι, μάρτυρα, voc. μάρτυς; dat. pl. μάρτῡσι(ν).
(11) ναῦς (ἡ), *ship*; νεώς, νηΐ, ναῦν, ναῦ; dual, νῆε, νεοῖν; pl. νῆες, νεῶν, ναυσί(ν), ναῦς. Compare γραῦς and βασιλεύς.
(12) οἶς(ἡ), *sheep*, οἰός, οἰί, οἶν; pl. οἶες, οἰῶν, οἶας, οἰσί(ν) or οἰεσι(ν), Homeric ὀΐεσσι(ν) or ὄεσσι(ν).
(13) οὖς(τό), *ear*, ὠτός, ὠτί; pl. ὦτα, ὤτων, ὠσί(ν).
(14) ὕδωρ(τό), *water*, ὕδατος, ὕδατι; dat. pl. ὕδασι(ν).
(15) υἱός (ὁ), *son*, υἱοῦ or υἱέος, υἱῷ (υἱεῖ or υἱέϊ); dual, υἱέε, υἱέοιν; pl. υἱεῖς, υἱέων, υἱέσι(ν).
(16) χείρ (ἡ), *hand*, χειρός, χειρί, χεῖρα; dual, χεῖρε, χεροῖν; pl. χεῖρες, χερσί(ν), poet. χείρεσσι or χείρεσι(ν).

Irregular Adjectives

There are also some irregular adjectives, such as μέγας (stem μεγα-), μεγάλη (stem μεγαλο-), μέγα, *great*, πολύς (stem πολυ-), πολλή (stem πολλο-), πολύ, *much*, and πρᾶος, πραεῖα, πρᾶον (stems πραο- and πραϊ-), *soft, gentle*, which are declined as follows :—

	Singular.			*Singular.*		
	Masc.	*Fem.*	*Neut.*	*Masc.*	*Fem.*	*Neut.*
N.	μέγας	μεγάλη	μέγα	πολύς	πολλή	πολύ
G.	μεγάλου	μεγάλης	μεγάλου	πολλοῦ	πολλῆς	πολλοῦ
D.	μεγάλῳ	μεγάλῃ	μεγάλῳ	πολλῷ	πολλῇ	πολλῷ
A.	μέγαν	μεγάλην	μέγα	πολύν	πολλήν	πολύ
V.	μεγάλε	μεγάλη	μέγα	[πολύ	πολλή	πολύ]
	Plural.			*Plural.*		
	μεγάλοι	μεγάλαι	μεγάλα	πολλοί	πολλαί	πολλά
	etc.			etc.		

	Singular.		
	Masc.	*Fem.*	*Neut.*
N.V.	πρᾶος	πραεῖα	πρᾶον
Gen.	πράου	πραείας	πράου
Dat.	πράῳ	πραείᾳ	πράῳ
Acc.	πρᾶον	πραεῖαν	πρᾶον
	Plural.		
N.V.	πρᾶοι or πραεῖς	πραεῖαι	πραέα
Gen.	πραέων	πραειῶν	πραέων
Dat.	πράοις or πραέσι (ν)	πραείαις	πράοις or πραέσι (ν)
Acc.	πράους	πραείας	πραέα
	Dual.		
N.A.V.	πράω	πραεία	πράω
G.D.	πράοιν	πραείαιν	πράοιν

There are two modes of forming the comparative and superlative. The first and by far the commonest is to add to the stem of the positive the suffix -τερος, -τερα, -τερον, for the comparative, and the suffix -τατος, -τατη, -τατον, for the superlative. The other is to add -ιων, -ιον for the comparative, and -ιστος, -ιστη, -ιστον, for the superlative. This second form applies to very few words, but these are words in common use.

Instead of these ordinary forms, the comparative may be expressed by the use of μᾶλλον, *more*, and the superlative by the use of μάλιστα, *most*, before the adjective, as μᾶλλον φίλος, μάλιστα φίλος, instead of φίλτερος, *dearer*, and φίλτατος, *dearest*.

Comparison of Adjectives

The following are examples of comparison by the first method. The stem, it will be noticed, frequently undergoes modification before the suffix. In stems ending in ο, this remains unchanged when the penultimate is long, but when this is short it is lengthened to ω, thus :—

Positive.	*Stem.*	*Comparative.*	*Superlative.*
ἰσχῡρός, *strong*	(ἰσχῡρο-)	ἰσχῡρό-τερος	ἰσχῡρό-τατος
κοῦφος, *light*	(κουφο-)	κουφό-τερος	κουφό-τατος
λεπτός, *thin*	(λεπτο-)	λεπτό-τερος	λεπτό-τατος
ἐχῡρός, *secure*	(ἐχῡρο-)	ἐχῡρώ-τερος	ἐχῡρώ-τατος
σοφός, *wise*	(σοφο-)	σοφώ-τερος	σοφώ-τατος

Contracted words in -εος, -οῦς undergo contraction in the comparative and superlative also, as :—

Pos.	πορφύρ-εος, *purple.*	πορφυρ-οῦς
Comp.	πορφυρ-εώ-τερος	πορφυρ-ώ-τερος
Super.	πορφυρ-εώ-τατος	πορφυρ-ώ-τατος

Four adjectives in -αιος (stem -αιο-), viz. γεραιός, *old*, παλαιός, *ancient*, περαῖος, *opposite*, and σχολαῖος, *idle, extensive*, drop the final ο of the stem, thus :—γεραιός (stem γεραιο-), γεραίτερος, γεραίτατος.

The following adjectives in -ος, viz., εὔδιος, *fine* (of weather), ἥσυχος, *calm*, ἴσος, *equal*, μέσος, *middle*, ὄρθριος, *early*, ὄψιος, *late*, πρῷος, *in the dawn*, change the ο of the stem to -αι, thus :—μέσος (stem μεσο-), μεσαίτερος, μεσαίτατος.

The following are normal formations, the comparative and superlative deprived of the suffix yielding the stem of the adjective :—

γλυκύς, *sweet*	(γλυκυ-)	γλυκύ-τερος	γλυκύ-τατος
μέλας, *black*	(μελαν-)	μελάν-τερος	μελάν-τατος
μάκαρ, *blessed*	(μακαρ-)	μακάρ-τερος	μακάρ-τατος
ἀληθής, *true*	(ἀληθεσ-)	ἀληθέσ-τερος	ἀληθέσ-τατος
πένης, *poor*	(πενεσ-)	πενέσ-τερος	πενέσ-τατος

Adjectives in -ων and a few others add the terminations -εστερος and -εστατος, also -ιστερος and -ιστατος, thus :—

εὐδαίμων	(εὐδαιμον-)	εὐδαιμον-έσ-τερος	εὐδαιμον-έσ-τατος
ἅρπαξ	(ἁρπᾰγ-)	ἁρπαγ-ίσ-τερος	ἁρπαγ-ίσ-τατος

So also ἄκρᾱτος, *unmixed*, ἄσμενος, *glad*, ἄφθονος, *abundant*, and ἐρρωμένος, *strong*, as ἐρρωμεν-έσ-τερος, ἐρρωμεν-έσ-τατος; ἀκρατ-έσ-τερος, ἀκρατ-έσ-τατος. So αἰδοῖος, -α, -ον, *modest*, has in the superlative αἰδοι-έσ-τατος.

Similarly contracted adjectives in -οῦς (-oos)

drop -ος and add -εστερος and -εστατος, thus :— εὔνους, *well-disposed*, εὐνούστερος, εὐνούστατος. Adjectives in -εις, -εν, change the final -εντ- of the stem to -εσ, thus: χαρίεις (stem χαριεντ-), χαριέστερος, χαριέστατος.

Some adjectives in -ος change ο into -ισ, as λάλος, *talkative*, λαλίστερος, λαλίστατος. So also μονοφάγος, *eating alone*, has the superlative μονοφαγίστατος and πτωχός, *poor*, has comparative πτωχίστερος, but superlative πτωχότατος.

The adjective ψευδής, *false*, drops -ης, and adds -ιστερος and -ιστατος, as in ψευδίστερος, ψευδίστατος, and the noun κλέπτης, *thief*, has the comparative κλεπτίστερος, *more thievish*, and the superlative κλεπτίστατος, *most thievish*.

Compounds of χάρις interpose ω between the stem and the suffix, as in ἐπίχαρις, *pleasing* (gen. ἐπιχάριτος), ἐπιχαριτώτερος, ἐπιχαριτώτατος.

The following are examples of comparison by the addition of the rarer suffixes -ιων, -ιον, and -ιστος, -ιστη, -ιστον :—

Positive.	*Comparative.*	*Superlative.*
αἰσχρός, *base*	αἰσχ-ίων	αἴσχ-ιστος
ἐχθρός, *hostile*	ἐχθ-ίων	ἔχθ-ιστος
ἡδ-ύς, *sweet*	ἡδ-ίων	ἥδ-ιστος
ταχ-ύς, *swift*	θάσσων or θάττων	τάχ-ιστος

It will be noticed that the final vowel of the stem is dropped before the suffixes. The superlatives are declined like ἀγαθός, the comparatives like the following, ἐχθίων, *more hostile*, μείζων, *greater* :—

Singular.

	M.F.	*N.*	*M.F.*	*N.*
Nom.	ἐχθίων	ἔχθιον	μείζων	μεῖζον
Gen.	ἐχθίονος		μείζονος	
Dat.	ἐχθίονι		μείζονι	
Acc.	ἐχθίονα or ἐχθίω, ἔχθιον		μείζονα or μείζω, μεῖζον	
Voc.	ἔχθιον		μεῖζον	

Plural.

N.V.	ἐχθίονες or ἐχθίους	ἐχθίονα ; or ἐχθίω	μείζονες or μείζους	μείζονα or μείζω
Gen.	ἐχθιόνων		μειζόνων	
Dat.	ἐχθίοσι(ν)		μείζοσι(ν)	
Voc.	ἐχθίονας or ἐχθίους	ἐχθίονα or ἐχθίω	μείζονας or μείζους	μείζονα or μείζω

Dual.

	More hostile.	*Greater.*
G.D.	ἐχθίονε	μείζονε
N.A.V.	ἐχθιόνοιν	μειζόνοιν

Adjectives of Irregular Comparison

The following are the principal of these :—

Positive.	*Comparative.*	*Superlative.*
ἀγαθός, *good*	ἀμείνων. βελτίων	ἄριστος, βέλτιστος
	κρείσσων or κρείττων, *stronger*	κράτιστος
	λώων	λῷστος
ἀλγεινός, *painful*	ἀλγίων	ἄλγιστος
κακός, *bad*	κακίων	κάκιστος
	χείρων	χείριστος
	ἧσσων or ἥττων	[ἥκιστα, *adv.*]
καλός, *beautiful*	καλλίων	κάλλιστος
μακρός, *long*	μακρότερος	μακρότατος
	μάσσων	μήκιστος
μέγας, *great*	μείζων	μέγιστος
μικρός, *small*	μικρότερος	μικρότατος
ὀλίγος, *little* (plur. *few*)	ἐλάσσων or ἐλάττων	ἐλάχιστος
	μείων	ὀλίγιστος
πέπων, *ripe*	πεπαίτερος	πεπαίτατος
πίων, *fat*	πιότερος	πιότατος
πολύς, *much*	πλείων or πλέων	πλεῖστος
ῥᾴδιος, *easy*	ῥᾴων	ῥᾷστος
φίλος, *dear*	φίλτερος	φίλτατος

Several adjectives expressing ideas of order or succession appear in the comparative and superlative only. Their stem will be found usually in a preposition or adverb of place, for example :—

From ἄνω, *up*	ἀνώτερος, *upper*	ἀνώτατος *uppermost*
From πλησίον, *near* (in Homer πλησίος)	πλησιαίτερος, *nearer*	πλησιαίτατος *nearest*
From πρό, *before*	πρότερος, *prior*	πρῶτος or πρώτιστος, *first*
From πρόσω, *forwards*	προσώτερος, *further, more in advance*	προσώτατος, *furthest*
From ὑπέρ, *over*	ὑπέρτερος, *higher*	ὑπέρτατος, *highest*
From ὑπό, *under*	ὕστερος, *posterior*	ὕστατος, *most behind*

The word *than* is represented by ἤ, with the same case after it as before ; thus, ὁ υἱὸς σοφώτερός ἐστιν ἢ ὁ πατήρ, *the son is wiser than the father*. Another form of comparison is to omit ἤ and put the second substantive in the genitive, as ὁ υἱὸς σοφώτερος τοῦ πατρός ἐστιν. The adverb ὡς, *as, thus*, used with a superlative, has the same meaning as the Latin quam ; for example, ὡς τάχιστα, quam cellerime, *as swiftly as possible*.

Vocabulary

ἀεί, *always, ever.*
ἀλλά, *but.*
ἀναγκαῖος, -α, -ον, *necessary.*
ἀναρχία, -ας, ἡ, *anarchy, lack of government.*
ἄνθος, -εος, τό, *flower.*
ἅπᾶς, ἅπᾶσα, ἅπαν, *quite all.*
ἀσφαλής, -ές, *firm, sure, trusty.*
βαθύς -εῖα, -ύ, *deep, high.*
γῆ, ἡ, *the earth, land.*
γνώμη, ἡ, *mind, judgment.*
δουλεία, ἡ *slavery, servitude.*
δουλεύω, *I am a slave (to).*
δοῦλος, ὁ, *slave.*
ἐλεύθερος, -α, -ον, *free.*
ἐνίοτε, *sometimes.*
εὐτυχής, -ές, *fortunate.*
ζῷον, -τό, *animal.*
ζωός, -ή, -όν, *alive, living.*
ἥβη, ἡ, *youth, prime.*
ἡδονή, ἡ, *pleasure.*
ἥλιος, ὁ, *the sun.*
ἰσχύω, *I am strong.*
καιρός, ὁ, *measure, opportunity, time.*
καρπός, ὁ, *fruit.*
κελεύω, *I order, command.*
κολακεία, ἡ, *flattery.*
κροκόδειλος, ὁ, *lizard, crocodile.*
κτῆμα, -ατος, τό, *possession.*
λοιπός, -ή, -όν, *remaining, left.*
λύπη, ἡ, *pain, grief.*
μέν -δέ, *on the one hand— on the other.*
μεταφέρω, *I transfer, alter.*
νόμος, ὁ, *law.*
ὀσμή, ἡ, *smell.*
ὄφις -εως, ὁ, *snake, serpent.*
πατρίς -ίδος (poet. fem. of πάτριος, *of one's forefathers, ancestors*), *native, ancestral*, ἡ πατρίς, *one's fatherland.*
παρέχω, *I supply.*
πείθω, *I persuade* (mid.), πείθομαι, *I obey.*
πλούσιος, -α, -ον, *rich, wealthy.*
πλοῦτος, ὁ, *wealth.*
πιστός, -ή, -όν, *faithful.*
πόλεμος, ὁ, *war.*
πρᾶγμα, -ατος, τό, *deed, fact, matter.*
πράσσω, *I do, effect, accomplish.*
σιωπή, ἡ, *silence.*
σπουδαῖος, -α, ον, *zealous, serious.*
σύμβουλος, -ου, ὁ, *adviser.*
σωφροσύνη, ἡ, *good sense, chastity.*
τίμιος, -α, -ον, *worthy, honoured.*
χρήσῖμος, -η, -ον, *useful.*
χελιδών, -όνος, ἡ, *swallow.*
χρόνος, ὁ, *time.*

Exercise 5

(*a*) Translate into English :—

1. Οὐδὲν ἥδιόν ἐστιν ἢ βαθὺς ὕπνος. 2. Οὐδὲν αἴσχιόν ἐστι τῆς δουλείας. 3. Οὐδὲν ἔχθιόν ἐστιν ἢ βουλὴ κακή. 4. Οἱ πονηροὶ ἄλλα μὲν ἐν τῷ νῷ ἔχουσιν, ἄλλα δὲ λέγουσιν. 5. Οὐδέν ἐστιν ἥδιον πιστοῦ φίλου. 6. Ὁ βαθύτατος ὕπνος ἥδιστός ἐστιν.

(*b*) Translate into Greek :—

1. Nothing is more hostile to man than man. 2. No law is stronger than necessity. 3. War brings very many evils. 4. A good woman brings to her house a great many good things. 5. Bear the necessities of life as lightly (easily) as possible. 6. To order is easier than to do.

Key to Exercise 3

(*a*). 1. True friendships arise through **virtue.** 2. They easily bear poverty. 3. Poverty is easily borne. 4. Learn wisdom, O youths. 5. Wisdom is learned. 6. The lovers of glory do not flee.

(*b*) 1. Φέρετε τὴν πενίαν ῥᾳδίως. 2. Βροντὴ ἐκ λαμπρᾶς ἀστραπῆς γίγνεται. 3. Ἡ ἀρετὴ ἐσθλὴν δόξαν ἔχει. 4. Ἀγαθὴν δίαιταν ἄγε. 5. Ἡ τύχη πολλάκις μεταβολὰς ἔχει. 6. Ἀπέχεσθε τῶν χαλεπῶν μεριμνῶν.

Key to Exercise 4

(*a*) 1. The boys are taught music. 2. The deeds do not tally with the words. 3. I am hit in the head. 4. I am ill in the eyes. 5. The prophet speaks false words. 6. Those in the market-place are taking flight.

1. Μὴ ψεύδη λέγε. 2. Θαυμάζομεν τὰ τῶν ἀνδρῶν κλέα. 3. Ἡ γῆ καλοῖς ἄνθεσιν θάλλει. 4. Σωκράτει πολλοὶ μαθηταί εἰσιν. 5. Λέγε ἀεὶ τὰ ἀληθῆ, ὦ παῖ. 6. ὦ Ἡράκλεις, τοῖς ἀτυχέσι σωτηρίαν πάρεχε. E. A. B.

ITALIAN.—III

Prepositions Contracted with Articles.—The following contractions commonly take the place of prepositions and articles. The contractions in **fra**, **tra**, and **per** are less used.

	il	**i**	**lo**	**gli**	**l'** (m. or f.)	**la**	**le**	
A, *to* or *at*	al	ai	allo	agli	all'	alla	alle	*to* or *at the.*
Con, *with*	col	coi	collo	cogli	coll'	colla	colle	*with the.*
Da, *from* or *by*	dal	dai	dallo	dagli	dall'	dalla	dalle	*from* or *by the.*
Di, *of*	del	dei (de')	dello	degli	dell'	della	delle	*of the.*
Fra, *among*	fral	frai	frallo	fragli	frall'	fralla	fralle	*among the.*
Tra, *among*	tral	trai	trallo	tragli	trall'	tralla	tralle	*among the.*
In, *in*	nel	nei	nello	negli	nell'	nella	nelle	*in the.*
Per, *for*	pel	pei	pello	pegli	pell'	pella	pelle	*for the.*
Su, *on*	sul	sui	sullo	sugli	sull'	sulla	sulle	*on the.*

Examples:—

Alle casse del negoziante.	*At the* or *to the cases* (packing cases, etc.) *of the merchant.*
Una rimessa dal cliente.	*A remittance from the customer.*
Gli studenti della scuola.	*The students of the school.*
Un uomo che conosco.	*A man whom I know.*
Coll' amico dei negozianti.	*With the friend of the merchants.*
Un' ora prima di partire.	*An hour before leaving.*
Sulla cassa nel magazzino.	*On the case in the warehouse* (shop).
Lo scopo dell' amico.	*The aim* (object) *of the friend.*
Agli scopi degli amici.	*To the aims of the friends.*
Dagli avventori (dai clienti) coi negozianti.	*From the customers with the merchants.*

Da also means **chez** (French), viz. *at the house of*, therefore **dagli avventori (dai clienti)** might also mean *at the customers' warehouse, shop, or house.*

All' avventore (al cliente) delle case.	*To the customer* (client) *of the houses.*
Nella casa della città.	*In the house of the city* (in the town house).
Sulla parola de' (dei) compratori.	*On the word of the buyers.*
Pel (per il) compratore nelle case estere.	*For the buyer in the foreign houses.*
Abbiamo il piacere di scrivervi oggi.	*We have the pleasure of writing you to-day.*

The **e** ending of the Infinitive is dropped when a pronoun, as here, is affixed.

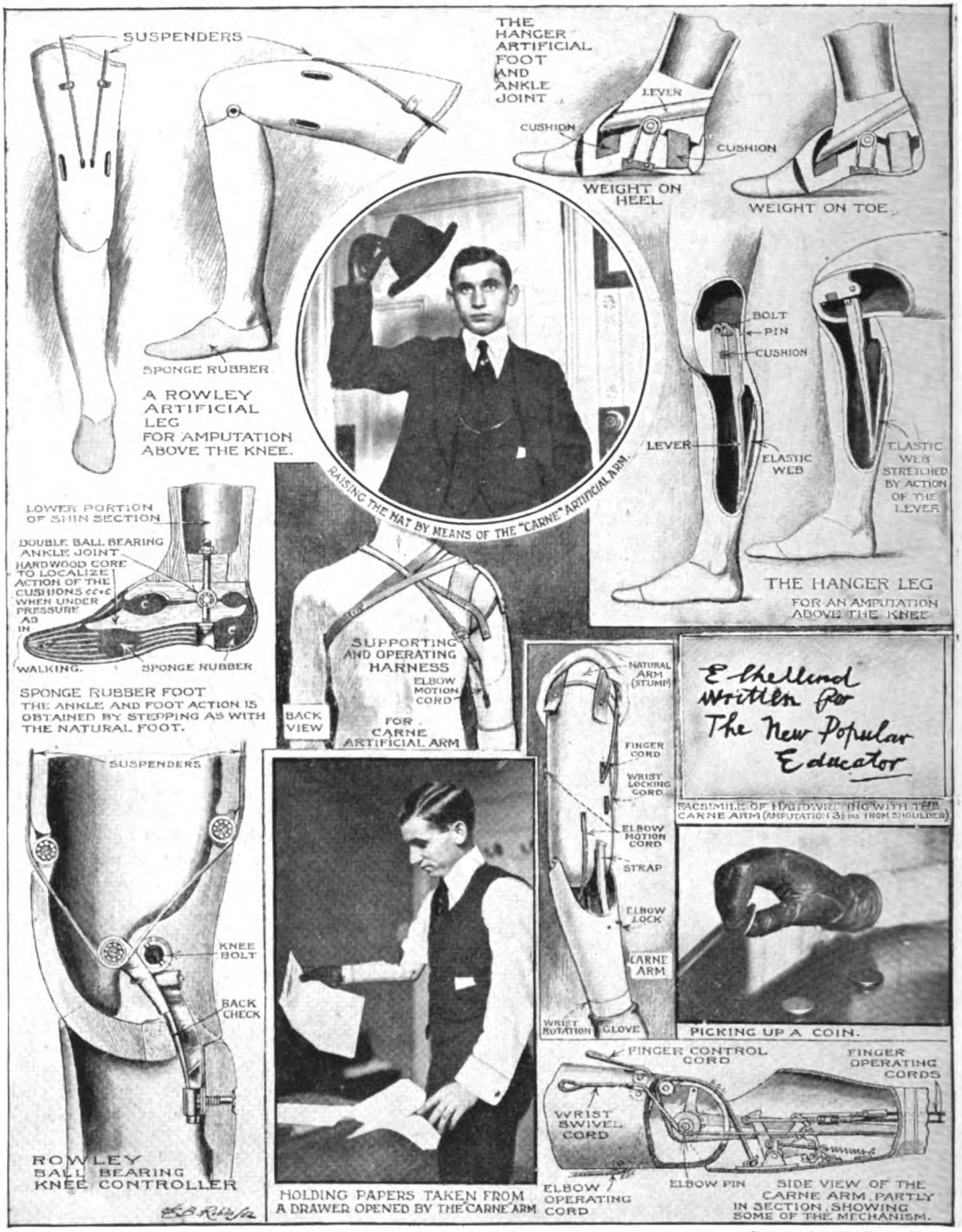
The Noun and Adjective.—As seen in the foregoing examples, most masculine nouns in the plural end in **-i**, and most feminine nouns end in **-e**. Feminine nouns ending in the singular in **-e** take **-i** in the plural, like masculine nouns. Adjectives follow the same rule, and vary in gender and number according to the noun they qualify ; those in **-o** vary as follows :

	Sing.	*Plur.*
Good =	**buono** (m.), **buona** (f.)	**buoni** (m.) **buone** (f.)

Adjectives generally follow the noun. Some, however, such as **bello**, *fine, beautiful ;* **brutto**, *ugly ;* **buono**, *good ;* **cattivo**, *bad ;* **grande**, *large, great ;* **piccolo**, *small ;* **santo**, *saint*, usually precede it.

VOCABULARY

alcuni (m. pl.), *some.*	Palermo, *Palermo.*
l'italiano (m.), *the Italian.*	dove, *where.*
il tempo, *the time.*	informare, *to inform.*



Drawn by W. B. Robinson.

MAN-MADE MEN.

If, during the Great War, man learned to destroy, he also learned to restore. The above drawings serve to demonstrate the wonderful ingenuity of modern artificial limbs and joints.

lieto, *glad, pleased.*
dire, *to tell, say.*
lo spedizioniere, *the carrier, shipper, forwarding agent.*
il rappresentante, *the representative.*
il ragioniere, *the accountant.*
il contábile, *the bookkeeper.*
il caso, *the case* (circumstance).
affermativo, *affirmative.*
abbiate (avere), *have* (imper. 2 pl.).
la bontà, *the goodness, kindness.*
il corrispondente, *the correspondent.*
osservare, *to observe, notice.*
curioso, *curious.*
la marca, *the mark.*
primo, *first.*
il treno, *the train.*
vengo (venire), *I come.*
andare, *to go, walk.*
lúi, *him* (follows verb or prepos.).
conversare, *to converse.*
generale (m. or f. sing.), *general.*
la garanzía, *the guarantee.*
definitivo, *definite.*
il fabbricante, *the manufacturer.*
entrare in, *to enter.*
visitare, *to visit.*
esaminare, *to examine.*
espressamente, *expressly.*
ne, *of it.*
parliamo (imper.), *let us speak.*
la produzione, *the production.*
portare, *to carry, bear.*
il nome, *the name.*
i géneri (pl. of **il génere**), *productions, articles, goods.*
óttimo, *excellent, best.*
véndersi, *to sell itself, be sold.*
il vostro, *your.*
il principale, *the principal* (head of a business, etc.).
sano e salvo, *safe and sound.*
che, *what.*
così . . . come, *as* (so) . . . *as.*
preferire di (or without the preposition **di**). *to prefer to* (infin.).
costì, *in your city, place.*
abbandonare, *to abandon.*
perchè, *because.*
volere, *to wish.*
negativo, *negative.*
il bisogno, *the want, need.*
bello, *beautiful, nice* (pl. **bei** before **a** consonant, **begl'** before **i**, **begli** before any other vowel or s impura, **belli** used independently).
scartare, *to reject.*
invece di, *instead of.*
offerire, *to offer*, past part. irreg., **offerto.**
quel, *that.*
il soggetto, *the subject.*
spiacévole, *disagreeable, unpleasant.*
spiegare, *to explain.*
com' è (come è), *how is it ?*
sperare di (or without the preposition **di**), *to hope to* (infin.).
pubblicare, *to publish.*
il migliore, *the best.*
la ditta, *the firm.*
l'esecuzione (f.), *the execution.*
dietro, *behind, according to.*
lo smercio, *the sale.*
avranno, (they) *will have.*
la casa editrice, *the publishing firm.*
circa, *about, concerning.*
l'avventore, *the customer* (of a shop—retail).
il cliente, *the customer* (wholesale).

Exercise 5

Translate into English :—

1. Abbiamo mandato alcuni campioni ai buoni clienti. 2. Ho parlato d'un uomo che conosco. 3. Gl'italiani che sono qui hanno pagato il conto. 4. E arrivata l'ora di andare al teatro ? 5. Siamo lieti di dirvi che sono arrivati gli amici. 6. Avete voi ricevuto una pólizza di cárico dallo spedizioniere ? 7. Sono venute le rimesse dai clienti ? 8. Due ore prima di partire ho veduto (*or* visto) il rappresentante della casa. 9. Ho dato i libri al ragioniere. 10. In caso affermativo abbiate la bontà di scrívere al corrispondente. 11. Sulle casse nei magazzini ho osservato certe marche curiose. 12. Sono venuti col primo treno. 13. Vengo adesso dall' avventore (dal cliente) che è stato dal negoziante. 14. Siamo andati da lúi per conversare un poco sulle cose in generale. 15. Hanno accettato le mercanzíe dietro la garanzía definitiva de' (dei) fabbricanti. 16. Siete entrati nelle case delle città che avete visitate per (or onde) esaminare i nuovi disegni. 17. L'ho (= lo ho) fatto espressamente pei (*or* per i) compratori di case éstere importanti. 18. E un bel (= bello) diesgno e ne abbiamo venduto grandi partite. 19. Non parliamo (imperative) più de' cattivi anni, ma parliamo de' buoni. 20. Siam (= siamo) certi che i nostri géneri avranno óttimo smercio costì (le nostre produzioni sono certe di véndersi bene costì).

Exercise 6

Translate into Italian :—

1. When did you (pl.) leave (translate, when are you left) for Palermo ? 2. They have received some letters from the same customers. 3. Where are the remittances which have come from the buyers ? 4. I am pleased to inform you that your principal has arrived this morning safe and sound. 5. At what time (translate, hour) did (is) he set out for the theatre ? 6. The small pattern is not of so good a quality (translate, so good quality) as the large one (omit). 7. It is an ugly affair, therefore I have preferred to abandon it. 8. We have refused the goods because the manufacturers have not wished to give us a guarantee. 9. In the (omit) negative case have the kindness to refuse the delivery. 10. If you came (are come, pl.) by the first train, how is it that you have arrived so late ? 11. Did you examine (have you examined) the new designs before giving the order ? 12. I want (have want of) small designs instead of the large ones which you have offered (pl.) me (translate, to me you have offered). The small ones are nice, but the large ones are ugly. 13. Do not let us speak any longer (more) about (of) that disagreeable subject. 14. They went (are gone) to him (da lúi) in order to explain to him (spiegargli) the matter. 15. The buyers of some important foreign houses have arrived in the city this afternoon. 16. We hoped (have hoped) to receive some nice orders from them. 17. These books have been published by (da) the best (publishing) firm in (of) the city. 18. The bill of lading did not bear (has not borne) the name of the shipper (forwarding agent). 19. He went to their house to converse with them about the execution of the orders. 20. I know the man who has written the letter, and I have spoken with him.

A. C.

SPANISH.—III

The Verb.—The Conditional Mood of *any* verb is formed by adding the endings of the Past Imperfect, viz :— **-ía, -ías, -ía, -íamos, -íais, -ían,** to the Infinitive, the latter being sometimes contracted or altered (exactly as for the future tense) in the case of irregular verbs, as in the Conditional Indicative of **Habèr** (Auxiliary Verb—Irregular) :—

	Sing.	*Plur.*
1.	habría, *I should have.*	habríamos, *we should have.*
2.	habrías, *thou wouldst have.*	habríais, *you would have* (familiar).
3.	habría, *he would have.* V. habría, *you would have.*	habrían, *they would have.* Vs. habrían, *you would have.*

Hablàr, *to speak* (regular), Conditional :—

Sing.	*Plur.*
1. hablar**ía,**	hablar**íamos.**
2. hablar**ías,**	hablar**íais.**
3. hablar**ía,**	hablar**ían.**

Ponèr, *to put* (irregular), Conditional.

Sing.	*Plur.*
1. pondr**ía,** *I should put,* etc.	pondr**íamos,** *we should put,* etc.
2. pondr**ías,** *you would put,* etc.	pondr**íais,** *you would put,* etc.
3. pondr**ía,** *he would put,* etc.	pondr**ían,** *they would put,* etc.

Examples

Harían (from hacèr) más, pèro no podèmos.	*We should do more, but we cannot.*
¿ Diría (from decìr) V. la verdàd en èse càso ?	*Would you tell the truth in that case ?*
Pudiéndo hacèr más, yo lo (it, so) habría hecho,	*Being able* (if I had been able) *to do more, I should have done so.*
Habríamos expedìdo los géneros en la fòrma prescrìta,	*We should have shipped the goods in the form prescribed.*
Vinièndo personalmènte, habríamos hècho mejòr.	*Coming* (by coming) *personally, we should have done better.*
Habrían provìsto á V. de tòdos los fòndos necesàrios.	*They would have provided* (to) *you with* (of) *all the money* (funds, capital) *necessary.*
¿ Habrían estudiàdo Vs. la lección ?	*Would you* (pl.) *have studied the lesson ?*

The Subjunctive Mood, Present Tense, of **Habèr,** *to have* (AuxiliaryVerb—Irregular) :—

Sing.	*Plur.*
1. cuàndo (yo) hàya, *when I have.*	cuàndo (nosòtros, -as) hayàmos, *when we have.*
2. cuàndo (tú) hàyas, *when thou hast.*	cuàndo (vosòtros, -as) hayáis, *when you* (familiar pl.) *have.*
3. cuàndo (él) hàya, *when he has.*	cuàndo (èllos, -as) háyan, *when they* (polite pl.) *have.*
cuàndo V. hàya, *when you* (polite sing.) *have.*	cuàndo Vs. hàyan, *when you* (polite pl.) *have.*

Formerly cuàndo, as also **si,** if, was sometimes used with the Future Subjunctive, but the latter is now always replaced in business language by the Present Subjunctive in the case of **cuàndo,** and by the Present Indicative in the case of **si.**

The Future Subjunctive of **Habèr** :—

Sing.	*Plur.*
1. hubi**ère,** *when I shall have,* etc.	hubi**èremos,** *when we shall have,* etc.
2. hubi**ères,** *when you will have,* etc.	hubi**èreis,** *when you will have,* etc.
3. hubi**ère,** *when he will have,* etc.	hubi**èren,** *when they will have,* etc.

Examples

Cuàndo yo hàya (old form, hubière) expedìdo la partìda, escribiré á Vs.
When I have forwarded the lot (*of goods*), *I shall write you.*
Si hèmos dìcho èsto, es la verdàd.
If we have said this, it is the truth.

If I had, etc., is rendered by the—

Imperfect Subjunctive of **Habèr, si yo hubièse,** as :—

Sing.	*Plur.*
1. hubi**èse,**	hubi**èsemos.**
2. hubi**èses,**	hubi**èseis.**
3. hubi**èse,**	hubi**èsen.**

The Conditional Subjunctive is often used instead of the Conditional Indicative, previously mentioned. It also frequently replaces the Imperfect Subjunctive.

The Conditional Subjunctive of **Habèr** :—

Sing.	*Plur.*
1. hubi**èra,** *I should have,* etc.	hubi**èramos,** *we should have,* etc.
2. hubi**èras,** *you should have.*	hubi**èrais,** *you should have.*
3. hubi**èra,** *he should have,* etc.	hubi**èran,** *they should have,* etc.

Examples

Si hubiésemos (hubiéramos) vìsto á Vs. ayèr, habríamos (Conditional Indicative, *or* hubiéramos, Conditional Subjunctive) explicàdo èsta circunstància.
If we had seen you yesterday, we should have explained this circumstance.

If the direct object (accusative case) of a transitive verb is a person, the latter is put in the dative case in Spanish, as: **He vìsto al hòmbre,** *I have seen* (to) *the man.*

VOCABULARY

mìsmo, *same.*
el corrèo, *the post, mail.*
la semàna, *the week.*
què, *who, which.*
viène (he) *comes* (from venìr, *to come*).
què viène, *coming, next* (literally, *that comes*).
el lugàr, *the place.*
àntes, *before.*
àntes de, *before* (of time, when followed by another word).
proveèr de, *to provide with.*
separàr, *to separate.*
separàdo, *separate* (adj.), *separated* (past part.).
cuàndo, *when.*
más, *more.*
el viajànte, *the traveller.*
el tièmpo, *the time.*
buèn, abbr. of buèno, *good.*
cualquièr, *any, whatsoever.*
servìr, *to serve.*
el vendedòr, *the salesman.*
bastànte, *sufficient.*
el negòcio, *the business.*
mañàna por la mañàna, *to-morrow morning* (literally, *to-morrow by the morning*).
la ciudàd, *the city.*
el papèl, *the paper.*
nuèvo, *new.*
la llegàda, *the arrival.*
el fàrdo, *the bale.*
la bàla, *the bale.*
la càja, *the case* (of wood, etc.).
la mèsa, *the table.*
el amìgo, *the friend.*
el cuàrto, *the room.*
había, *there was, were.*
ofrecèr, *to offer.*
la pèna, *the trouble.*
èllos, *they, them.*
jòven, *young.*

The following table shows the parts already given of the auxiliary verb **habèr,** also its present and past participles :—

Infinitive Mood

Habèr, *to have*

Present Participle, **habièndo,** having. Past Participle, **habìdo,** had.

Indicative Mood

	yo	tú	él (ella, V.)	nosòtros (-as)	vosòtros (-as)	éllos (ellas, Vs.)
Present Tense—						
I have, etc.	he	has	ha	hèmos	habéis	han.
Past Imperfect Tense—						
I had, etc.	había	habías	había	habíamos	habíais	habían.
Future Tense—						
I shall have, etc.	habré	habrás	habrá	habrèmos	habréis	habrán.
Conditional—						
I should have, etc.	habría	habrías	habría	habríamos	habríais	habrían.

Subjunctive Mood

Present Tense—						
I have, etc.	hàya	hàyas	hàya	hayàmos	hayáis	hàyan.
Past Imperfect—						
I had, etc.	hubièse	hubièses	hubièse	hubiésemos	hubièseis	hubièsen.
Future Tense—						
I shall have, etc.	hubière	hubières	hubière	hubiéremos	hubièreis	hubièren.
Conditional—						
I should have, etc.	hubièra	hubièras	hubièra	hubiéramos	hubièrais	hubièran.

Exercise 3

Translate into English :—

1. No habríamos vuèlto los géneros á V. 2. ¿ Habrán vìsto Vs. á (not translated) los clièntes en el almacén ? 3. Ellos habían estudiàdo la lección. 4. ¿ Qué habríamos puèsto en (*or* sòbre) la mèsa ? 5. Habré mandàdo las càrtas por el mismo corrèo. 6. Pidièndo las mercancías mañàna, las (them) recibirèmos la semàna que viène. 7. ¿ Qué habría hècho V. en mi lugàr ? 8. El sòcio había muèrto mùcho àntes. 9. Ya habían escrìto sòbre èste asùnto. 10. El habría seguìdo las instrucciònes prescrìtas en la nota de pedìdo. 11. Vs. habrán provìsto á (omit) sus amìgos de tòdos los fòndos necesàrios. 12. Pondrèmos los géneros en un cuàrto separàdo. 13. Mi representànte pondrá el asùnto en mànos de un abogàdo. 14. Habrían puèsto á aquèl hòmbre en mi lugàr. 15. Cuàndo habíamos dìcho tòdo, no había más tièmpo pàra cogèr el tren. 16. Pudièndo (being able, though you were able) pagàr la cuènta, V. no lo (*it*, direct object) ha hècho. 17. Sintièndo mùcho la pérdida de èste buèn clièntе, habrían hècho cualquièr sacrificio para servirle (le = him) y recibìr sus pedìdos. 18. Habièndo dìcho èsto, el vendedòr me ha ofrecìdo las zaràzas á un prècio mùy bàjo. 19. Habríamos vísto primero, si valía la pena. 20. Dicièndo (*In* or *by* saying) èso, V. ofendería mùcho al representànte de la càsa. 21. Cuàndo hayàmos (old form : hubiéremos) expedìdo los géneros, escribirèmos á èllos. 22. Si èl hubièse (hubièra) hècho èsto, nos (to us) habría (hubièra) escrìto.

Exercise 4

Translate into Spanish :—

1. By coming (translate merely, *coming*) early, you (pl.) have seen the (to the) new customer. 2. The train would have arrived earlier (translate, more early), before nine o'clock. 3. I should have done my lesson. 4. He will have put the electric light in the offices. 5. You (pl.) had paid the money to the merchant's cashier. 6. Do you (pl.) know (know you) whether the client's buyer had covered the patterns before going out ? (translate, to go out). 7. Why would (translate, Why would not have arrived, etc.) our traveller not have arrived earlier ? 8. We had not seen the patterns which you had handed over to our traveller. 9. The package would have arrived broken. 10. They will have returned before the arrival of the traveller. 11. I shall have opened the bales and the cases. 12. (In) dying so young, he will not have left sufficient capital to (in order to) carry on (translate, to do) the business. 13. Shall I have received the letter before arriving (translate, to arrive) to-morrow morning ? 14. Had the head of the house died (translate, Had died the head, etc.) before my arrival in this (f.) city ? 15. We should have seen you in the warehouse if you had (subjunctive mood) arrived earlier. 16. I should have spoken with you on this subject, if you had (subjunctive) arrived before nine o'clock. 17. They would have delivered the goods, if you had (subjunctive) paid the account. 18. The printer would have printed the circulars, if he had (subjunctive) received the paper. 19. We should have spoken to you (pl.) if we had (subjunctive) been able to see you. 20. What would you have said, if we had (subjunctive) returned yesterday ? 21. When you (pol. pl.) have returned, come (véngan Vs.) to the house. 22. We should have seen the drawer of the draft, if we had not received it to-day. 23. If the bill is not paid at (the) maturity, we shall have it protested (*mandar protestar*, to get protested). 24. When they have shipped the goods, they will draw a draft on our firm (house). 25. The signatures of the drawers, endorsers and endorsees are well known.

A. C.

Continued from page 357.

GEOGRAPHY:

Contributors:—Robert Finch, F.R.G.S.; W. H. Koebel; Sir John Scott-Keltie, LL.D.; Cyril J. Silverston, B.Sc.(Lond.).

AFRICA.—III

THE political divisions of Africa are by no means the least interesting attributes of what was once known as the "Dark Continent." With the exception of Russia and Austria, there is not a single European nation of imperial consequence which has not colonised there. Britain, France, Belgium, Germany, Portugal, Spain, Italy, and Holland—all these have, or have had, their empire in some part or other of the Continent. Nations, such as the Dutch, have held dominion there and lost it—a fate that has just been shared by a larger nation.

The Empire of Abyssinia

Before dealing with the British possessions in Africa we may glance at the areas occupied by the other European nations. These comprise almost the entire remainder of the continent, for the only parts where the original inhabitants have been allowed to retain any territorial control in a political sense are comprised by a small state or two in the north and north-west, the empire of Abyssinia in the north-east, and the republic of Liberia in the west.

This latter state presents a curious phenomenon, and is rather an experiment in colonisation by civilised negroes than a continuance of any form of government which the country had previously known. It is in its way a stranger to the original soil, and as exotic as any of the European civilisations which have been introduced into tropical Africa.

To begin with the political divisions of the north of the continent, it is only natural that this coast line should have come under the influence of those Southern European countries which lie opposite to it. Thus to the west of Egypt extends Tripoli and Cyrenaica, an Italian Protectorate, and west of this again is Algeria, the French coastal territory which lies to the north of the great Desert of Sahara, likewise under French influence, to which it serves as the outlet.

To the west of this again is the Barbary state of Morocco, and the Spanish Protectorate of Morocco. To the south and east of this latter, stretches the vast inland country of the French Sudan, an enormous area which serves as a territorial background to every coastal state on the west almost as far south as the Equator!

Viewed from a political point of view, these western coastal states to the north of the Equator constitute a heterogeneous collection. Following the coast to the south and east of Cape Verd, the western extremity of the great shoulder of the Continent, we arrive at the Portuguese Settlement of Bissao or Guinea, French Guinea, and then at the negro republic of Liberia, to which reference has already been made. After this the great French interior of the north-west of the Continent breaks through to the coast again under the name of the Ivory Coast.

Equatorial Africa

Then, set in the hollow beneath the left shoulder of Africa is the extensive area known as the Cameroons, with Spanish Guinea set in the middle of its coast. To the south of this is the narrow coastal strip of the Belgian Congo, the boundaries of which, when once well away from the South Atlantic Ocean, extend themselves far and wide, to include nearly the whole of what is generally known as Equatorial Africa.

Beneath this again, extending towards the south to a more temperate climate, are the broad territories of Portuguese West Africa.

The east coast of the Continent, although it cannot equal the cosmopolitan abundance of the possessions of Western Africa, is by no means lacking in variety of ownership.

Photo: Sir H. H. Johnston.

A GROUP OF CHIEFS

of the northern part of the Congo basin, a region where there is a considerable Negroid, as opposed to Negro, element in the population.

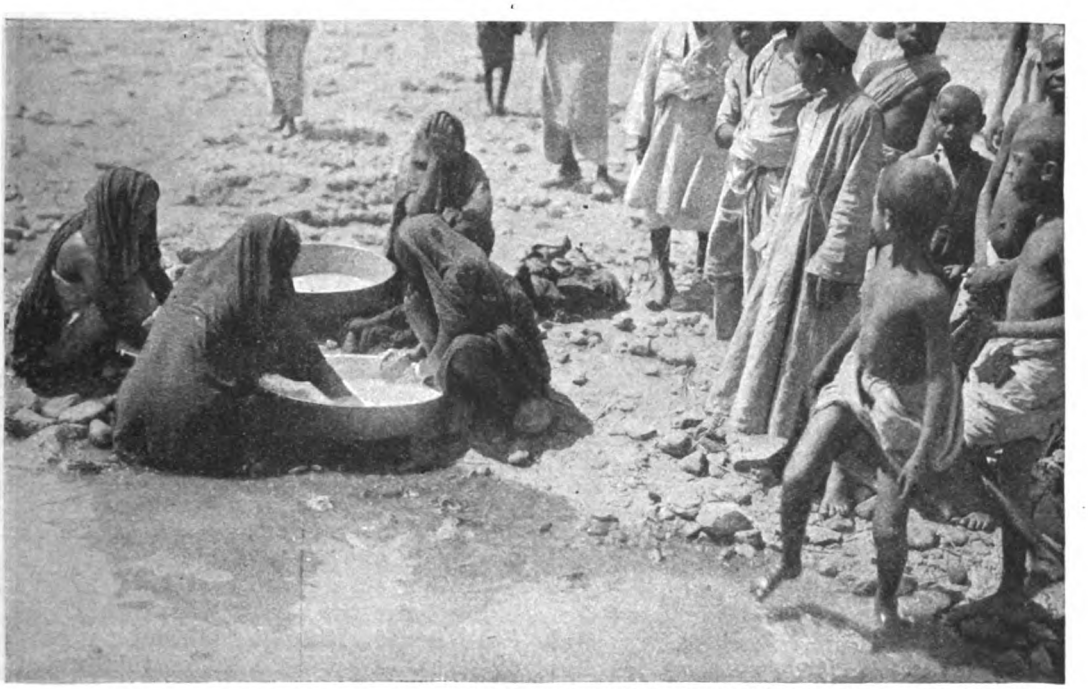
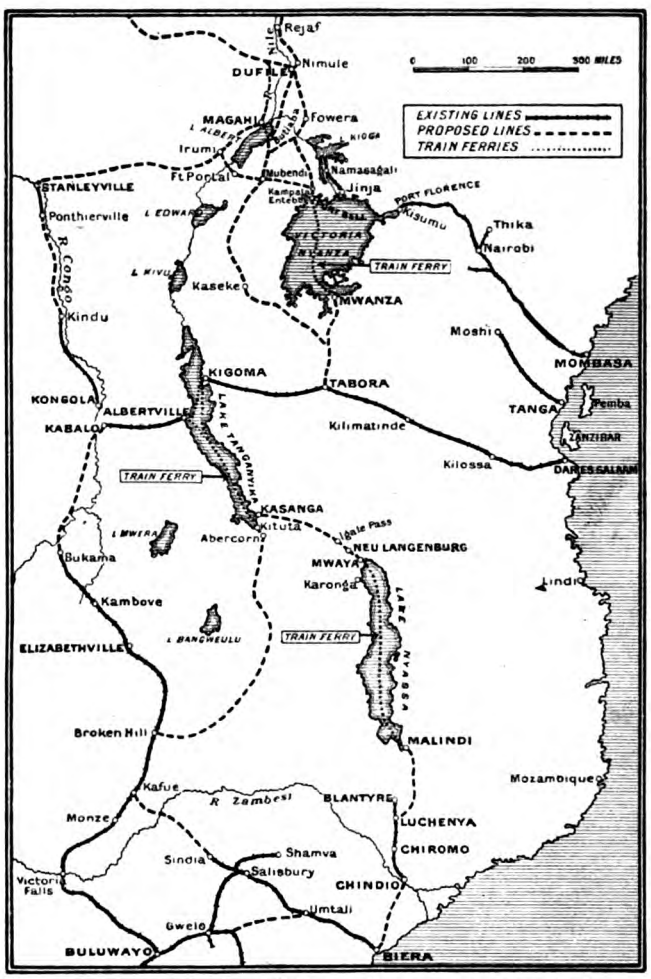


Photo: by permission of the Sudan Government Railways and Steamers.

WASHING DAY AT OMDURMAN

where Lord Kitchener, in September, 1898, by his decisive victory over the forces of the Khalifa, finally established British supremacy in the Sudan.

Starting downwards from south-east of the Sudan, we arrive first of all at the Italian Colony of Massawa, a territory which has cost the Latin peninsula no little blood and treasure. To the south of this extends the largely mountainous and arid country of the independent state of Abyssinia. Where the torrid coast of this state ends is the French settlement of Jibuti, opposite Aden, just below the southernmost extremity of the Red Sea. To the south-east of this again, helping to form the angular eastern shoulder of the Continent, is Italian Somaliland.



In connection with the All-Red railway route from Cairo to the Cape, it is proposed to utilise the great lakes for train ferry purposes. The above map shows how the lakes are linked by railways, existing or projected.

Just below the Equator begins the East African Protectorate, which is bounded on the south by Portuguese East Africa. This latter colony, with its unusually long coast line, concludes the long and varied list of the European possessions of Africa, exclusive of those of the British Empire, to which we may now turn.

Of the various European empires in Africa, the British is very much the largest. It includes every latitude, and every climate—from that of the bracing uplands of the south, the malarious atmosphere of the steaming forests, the healthier heat of the great river valleys of the centre, to the dry airs of the mountains, deserts, and rich alluvial soil of the Nile country.

British Possessions

To deal first of all with the western colonies, we may begin from the north with the small protectorate of Gambia. To the south of this is Sierra Leone, while to the east of this latter a narrow strip of French territory separates the British possessions of the Gold Coast and Nigeria. These regions, abounding though they do in tropical riches, are not to be ranked among the most important of the British African possessions if for no other reason that their climate is eminently unsuited to the European.

On the east coast of the continent Egypt is now a completely British possession, and thus has become one with its southern neighbour the Sudan.

Beneath the Sudan, and extending along the south of Abyssinia, is British East Africa, which has on its south the great lake of Victoria Nyanza, and the territories of the East African Protectorate. Before the Great War it was this particular stretch of territory which threatened to interrupt the all-British Line from Cairo to Cape Town.

To the south of the East African Protectorate begin the great territories of British South Africa. Rhodesia is the most northern of these. To the south of this extends Bechuanaland, the Transvaal, the Orange Free State, Natal, Basutoland, and the Cape of Good Hope—the countries, in fact, which go to make up the Union of South Africa.

Until the latter end of the nineteenth century the sole railways of the least con-

sequence were those of British South Africa, of Northern Egypt, and of the French northern possessions.

The period of the "Dark Continent" is now at an end, and a formidable system of railways has already been instituted. From the British point of view—and, indeed, from that of the entire continent—the most important of all these systems is that of the Cape-to-Cairo railway, one of the truest imperial schemes which has developed in the world's history. As it is, but for a break in the lines between Assuan and Wady Halfa, it would be now possible to travel by rail from Alexandria to El Obeid, the capital of Kordofan, in the S.E. Sudan. South of this yawns the great gulf in the railway lines. It is impossible to estimate how many years will lapse before this is bridged. But it is certain enough that the feat will be achieved one day, and that the lines from the north will meet with those already creeping up through Rhodesia.

Cape-to-Cairo Railway

In addition, it must be said that there is another great African railway project which runs the Cape-to-Cairo line very closely in importance, and which, when the imposing scheme is realised, cannot fail to bring great benefits to the British empire in Africa. This is the Trans-Saharan Railway starting inland from the north-western coast.

Of course, numerous minor, but nevertheless sufficiently important, lines, which will eventually become associated with these great systems, are already in existence. There are the railways of the interior, such as the British lines in Uganda, and such lines as the French Upper Niger, and Dahomey hinterland railways; the British Sierra Leone, and Gold Coast railways, and the lines from Lagos. There are the French Gaboon Coast railways, and the Belgian railways of the Congo. There are, moreover, the German-built railways of the Cameroons, etc.

As might be expected, it is in British South Africa that the network of railways is the most imposing. The main line here is from Cape Town to De Aar, where a junction exists with the main route from Port Elizabeth. Thence it proceeds northwards with a slight easterly trend to Mafeking and Buluwayo, and by way of the Victoria Falls and Elizabethville into the Belgian Congo. Johannesburg is reached by way of De Aar junction, Bloemfontein and Pretoria. There is also a line from East London to Bloemfontein. Then there are the lines proceed-

CAIRO TO THE CAPE

through the now All-Red (indicated by a darker tint) area of Africa. *See opposite.*

ing into Natal, and beyond it, from Durban; and the railways from Beira and Lourenço Marques (Delagoa Bay) which serve Mashonaland and Pretoria respectively.

These will suffice to give some idea of the railway ramifications of South Africa. Some of the lines which can claim importance from the international point of view are the railways connecting Capetown with Portuguese South-East Africa; the line which joins Lake Nyasa and the Shiré country with the Zambezi; the lines connecting Mozambique with the Nyasa system; and the German-built railway from Dar-es-Salaam to the shores of Lake Tanganyika. Beyond these there is the railway from Mombasa to the Victoria Nyanza and Uganda; and the line connecting the French port of Jibuti, at the entrance of the Red Sea, with the capital of Abyssinia.

Lesser Railways

The railway from Port Sudan to Khartum is a line which must eventually produce an effect on the littoral of the Red Sea.

On the west coast, principally within fifteen degrees north of the Equator, are a number of short lines running directly inland, each serving the country immediately at the back of its own port, the system not being yet sufficiently advanced to permit of any ramifications. The remaining railways of Africa are those of the Algerian system, by means of which it is possible to travel from Fez to Tunis, and from Tunis to the confines of the Sahara desert.

The traffic on the inland waters of Africa is considerable. The time-honoured method is by canoe or dahabíyeh. Canoes and rafts, indeed, play an important part on the rivers Zambezi, Shiré, Bahr-al-ghazal and on the lakes Victoria Nyanza, Tanganyika, and Nyasa. These small craft act not only as passenger vessels but as carriers of cargo. The large lakes and the more important stretches of the rivers are now provided with steamers and motor launches.

River Navigation

From the point of view of the larger vessels the navigation of the rivers is disappointing. The sole streams of Africa which admit ships of any importance at all are the Gambia, the Old Calabar, and the Congo. With the exception of Australia, it is thus the most poorly supplied in this respect of all the continents—for rapids prevent the continuity of travel on the great streams, and the navigation of their mouths is impeded by bars. W. H. K.

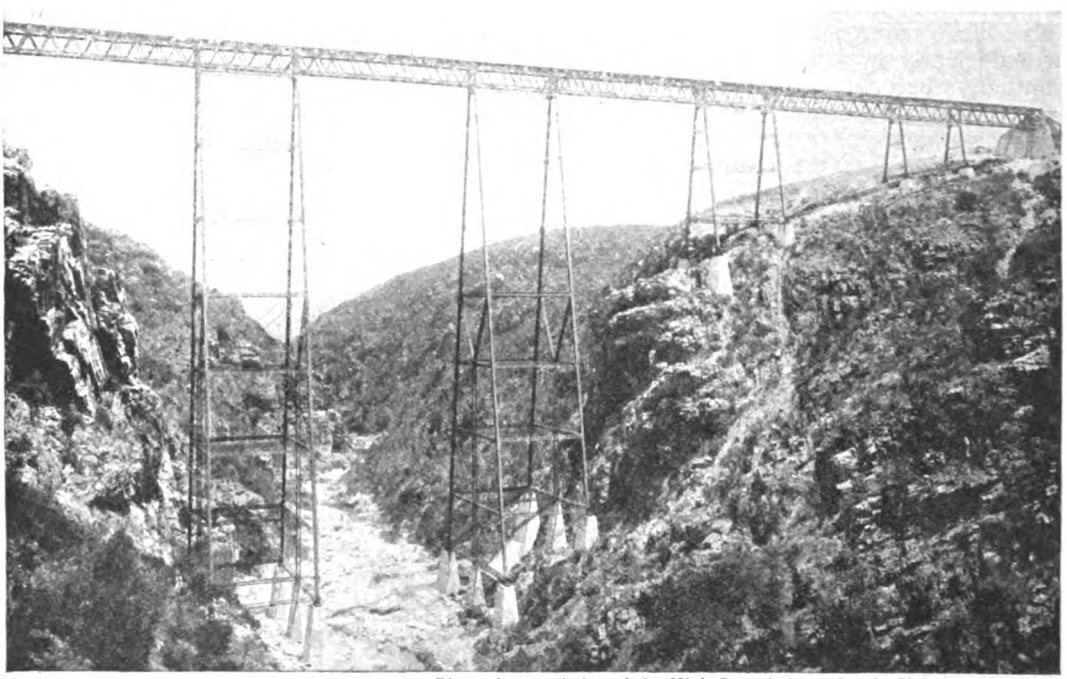


Photo: by permission of the High Commissioner for the Union of S. Africa.

Viaduct on the Port Elizabeth-Mortimer narrow gauge (two foot) Railway.

Continued from page 363.

MATHEMATICS:

Contributor: — ARITHMETIC, ALGEBRA, GEOMETRY, CO-ORDINATE GEOMETRY, TRIGONOMETRY, MECHANICS, MENSURATION, ETC.
(M. A. Lewenz, M.A.[Lond.]).

TRIGONOMETRY.—III

25. Geometrical proof of the equations (iv) on page 234, concerning the sum and difference of the sines and cosines of two angles.

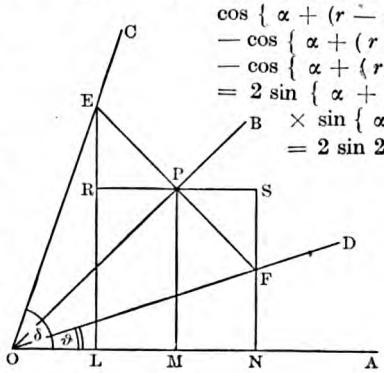
Draw the angle A O C = δ and the angle A O D = θ, then angle C O D = $\delta - \theta$.

Bisect the angle C O D by the straight line O B.

Then C O B = B O D = $\frac{1}{2}(\delta - \theta)$

$\therefore$ A O B = A O D + D O B = $\theta + \frac{1}{2}(\delta - \theta) = \frac{1}{2}(\delta + \theta)$.

In O B take any point P and draw E P F perpendicular to O B cutting O C, O A in E and F respectively.



Draw E L, P M, F N perpendicular to O A, and through P draw R P S perpendicular to L E and N F produced.

Then by plane geometry we know that

O E = O F; E L + F N = 2 P M; E L − F N = 2 E R; O L + O N = 2 O M; O N − O L = 2 L M = 2 R P.

Also in triangle P E R,

angle P E R = 90° − $\angle$ E P R = $\angle$ R P O = $\angle$ P O L

but $\angle$ P O L is $\angle$ B O A = $\frac{1}{2}(\delta + \theta)$

Hence,

$$\sin\delta + \sin\theta = \frac{EL}{OE} + \frac{FN}{OF} = \frac{EL + FN}{OE} = 2\frac{PM}{OE}$$

$$= 2\frac{PM}{OP}\cdot\frac{OP}{OE} = 2\sin\frac{\delta+\theta}{2}\cdot\cos\frac{\delta-\theta}{2}$$

$$\sin\delta - \sin\theta = \frac{EL - FN}{OE} = \frac{2ER}{OE} = 2\frac{ER}{EP}\cdot\frac{EP}{OE}$$

$$= 2\cos\frac{\delta+\theta}{2}\cdot\sin\frac{\delta-\theta}{2}$$

$$\cos\delta + \cos\theta = \frac{OL + ON}{OE} = \frac{2OM}{OE} = 2\frac{OM}{OP}\cdot\frac{OP}{OE}$$

$$= 2\cos\frac{\delta+\theta}{2}\cdot\cos\frac{\delta-\theta}{2}$$

$$\cos\theta - \cos\delta = \frac{ON - OL}{OE} = \frac{2RP}{OE}$$

$$= 2\frac{RP}{EP}\cdot\frac{EP}{OE}$$

$$= 2\sin\frac{\delta+\theta}{2}\cdot\sin\frac{\delta-\theta}{2}.$$

26. Examples of the use of the formulæ

(1) Show that $\dfrac{\sin 2\theta + \sin\theta}{\cos\theta + \cos 2\theta} = \tan\dfrac{3\theta}{2}$.

$$\frac{\sin 2\theta + \sin\theta}{\cos\theta + \cos 2\theta} = \frac{2\sin\frac{3\theta}{2}\cdot\cos\frac{\theta}{2}}{2\cos\frac{3\theta}{2}\cdot\cos\frac{\theta}{2}} = \frac{\sin\frac{3\theta}{2}}{\cos\frac{3\theta}{2}}$$

$$= \tan\frac{3\theta}{2}$$

(2) Express as a product

$$\cos\{\alpha + (r - \tfrac{1}{2})\beta\} - \cos\{\alpha + (r + \tfrac{1}{2})\beta\}\cos\alpha\{\alpha + (r - \tfrac{1}{2})\beta\} - \cos\{\alpha + (r + \tfrac{1}{2})\beta\}$$

$$= 2\sin\{\alpha + (r - \tfrac{1}{2})\beta + \alpha + (r + \tfrac{1}{2})\beta\} \times \sin\{\alpha + (r + \tfrac{1}{2})\beta - \alpha - (r - \tfrac{1}{2})\beta\}$$

$$= 2\sin 2(\alpha + r)\beta\cdot\sin\beta$$

(3) Find $\cos(\alpha + \beta + \gamma)$ in terms of the cosines and sines of α, β and γ and hence show that if $\alpha + \beta + \gamma = 90°$,

$$\tan\beta\cdot\tan\gamma + \tan\gamma\cdot\tan\alpha + \tan\alpha\cdot\tan\beta = 1$$

$$\cos(\alpha + \beta + \gamma) = \cos\{(\alpha + \beta) + \gamma\}$$

$$= \cos(\alpha + \beta.)\cos\gamma - \sin(\alpha + \beta).\sin\gamma$$

$$= (\cos\alpha\cos\beta - \sin\alpha\sin\beta)\cos\gamma - (\sin\alpha\cos\beta + \cos\alpha\sin\beta)\sin\gamma$$

$$= \cos\alpha.\cos\beta\cos\gamma - \sin\alpha\sin\beta\cos\gamma - \sin\alpha\cos\beta\sin\gamma - \cos\alpha\sin\beta\sin\gamma$$

If $\alpha + \beta + \gamma = 90°$, $\cos(\alpha + \beta + \gamma) = 0$

$\therefore \cos\alpha\cos\beta\cos\gamma - \sin\alpha\sin\beta\cos\gamma - \sin\alpha\cos\beta\sin\gamma - \cos\alpha\sin\beta\sin\gamma = 0$

Divide throughout by $\cos\alpha\cos\beta\cos\gamma$, then $\tan\alpha\cdot\tan\beta + \tan\gamma\cdot\tan\alpha + \tan\beta\tan\gamma = 1$

(4) Show that $\sin\dfrac{11\theta}{4}\cdot\sin\dfrac{\theta}{4} + \sin\dfrac{7\theta}{4}\cdot\sin\dfrac{3\theta}{4}$

$$= \sin 2\theta\cdot\sin\theta\sin\frac{11\theta}{4}\cdot\sin\frac{\theta}{4} + \sin\frac{7\theta}{4}\cdot\sin\frac{3\theta}{4}$$

$$= \tfrac{1}{2}\{\cos\frac{5\theta}{2} - \cos 3\theta\} + \tfrac{1}{2}\{\cos\theta - \cos\frac{5\theta}{2}\}$$

$$= \tfrac{1}{2}\{\cos\theta - \cos 3\theta\} = \tfrac{1}{2}\text{ of } 2\sin 2\theta\cdot\sin\theta$$

$$= \sin 2\theta\cdot\sin\theta$$

(5) Solve the equations

$4 \sin(\theta + \xi) \cdot \cos(\theta - \xi) = 3$ ..... (i)

$4 \cos(\theta + \xi) \cdot \sin(\theta - \xi) = 1$ ..... (ii)

from (i) $2\{\sin 2\theta + \sin 2\xi\} = 3$

from (ii) $2\{\sin 2\theta - \sin 2\xi\} = 1$

adding $4 \sin 2\theta = 4 \therefore \sin 2\theta = 1$

$\therefore 2\theta = 90° \therefore \theta = 45°$

subtracting $4 \sin 2\xi = 2 \therefore \sin 2\xi = \frac{1}{2}$

$\therefore 2\xi = 30° \therefore \xi = 15°$

27. (1) Prove that

$\sin^2 x + \sin^2 y + \sin^2 z + \sin^2(x + y + z)$

$= 2\{1 - \cos(y + z) \cdot \cos(z + x) \cos(x + y)\}$

or $\sin^2 x + \sin^2 y + \sin^2 z + \sin^2(x + y + z)$

$= 2 - 2 \cos(y + z) \cos(z + x) \cos(x + y)$

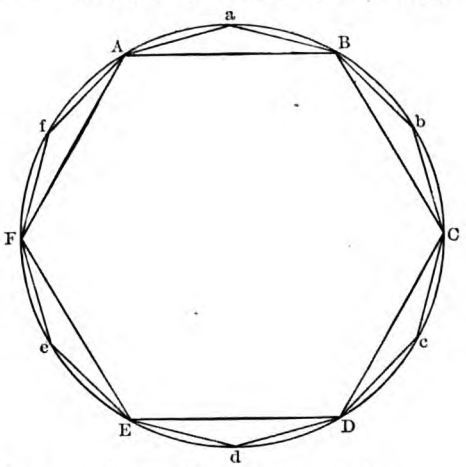
or $\sin^2 x - 1 + \sin^2 y - 1 + \sin^2 z$

$+ \sin^2(x + y + z)$

$= -2 \cos(y + z) \cos(z + x) \cos(x + y)$

or $-\cos^2 x - \cos^2 y + \sin^2 z + \sin^2(x + y + z)$

$= -2 \cos(y + z) \cos(z + x) \cos(x + y)$



Now consider the left-hand side of this.

We know $\cos(\alpha + \beta) \cos(\alpha - \beta)$

$= \cos^2 \alpha - \sin^2 \beta$

hence the left-hand side

$= -(\cos^2 x - \sin^2 z) -$

$\{\cos^2 y - \sin^2(x + y + z)\}$

$= -\cos(x + z) \cos(x - z)$

$-\cos(x + 2y + z) \cos(x + z)$

$= -\cos(x + z)\{\cos(x - z) + \cos(x + 2y + z)\}$

$= -\cos(x + z) \times 2 \cos(x + y) \cos(y + z)$

$= -2 \cos(x + y) \cos(y + z) \cos(z + x)$

which was to be proved.

(2) Prove that

$$8 \cos \frac{\alpha + \beta + \gamma}{2} \cdot \cos \frac{\beta + \gamma - \alpha}{2} \cdot \cos \frac{\gamma + \alpha - \beta}{2} \cos \frac{\alpha + \beta - \gamma}{2}$$

$= \cos 2\alpha + \cos 2\beta + \cos 2\gamma + 4 \cos \alpha \cos \beta \cos \gamma + 1$. Now

$$8 \cos \frac{\alpha + \beta + \gamma}{2} \cdot \cos \frac{\beta + \gamma - \alpha}{2} \times \cos \frac{\gamma + \alpha - \beta}{2} \cdot \cos \frac{\alpha + \beta - \gamma}{2}$$

$$= 2\left\{2 \cos \frac{\alpha + \beta + \gamma}{2} \cdot \cos \frac{\beta + \gamma - \alpha}{2} \times 2 \cos \frac{\gamma + \alpha - \beta}{2} \cdot \cos \frac{\alpha + \beta - \gamma}{2}\right\}$$

$= 2\{\cos(\beta + \gamma) + \cos \alpha\}\{\cos \alpha + \cos(\beta - \gamma)\}$

$= 2 \cos \alpha\{\cos(\beta + \gamma) + \cos(\beta - \gamma)\} + 2 \cos^2 \alpha$

$+ 2 \cos(\beta + \gamma) \cos(\beta - \gamma)$

$= 4 \cos \alpha \cos \beta \cos \gamma + \cos 2\alpha - 1$

$+ (2 \cos^2 \beta - 2 \sin^2 \gamma)$

$= 4 \cos \alpha \cos \beta \cos \gamma + \cos 2\alpha - 1$

$+ \cos 2\beta + 1 + \cos 2\gamma - 1$

$= \cos 2\alpha + \cos 2\beta + \cos 2\gamma$

$+ 4 \cos \alpha \cos \beta \cos \gamma + 1$

Exercise 4

Transform the following into the sums or differences of two cosines or two sines.

(1) $2 \cos 5a \cos a$. (2) $2 \sin 10a \sin 3a$.

(3) $2 \sin 5a \cos a$. (4) $2 \cos 10a \sin 3a$.

(5) $\sin 3\theta \sin(2\xi - 3\theta)$.

(6) $\cos(30° + 2\alpha) \sin(30° - \alpha)$.

Transform the following into products of sines and cosines.

(7) $\cos 10\alpha + \cos 2\alpha$. (8) $\sin 15\alpha - \sin 11\alpha$.

(9) $\sin 4\alpha + \sin 2\alpha$. (10) $\cos \frac{\theta}{2} - \cos \frac{5\theta}{2}$.

(11) $\cos(2\gamma - \delta) - \cos 3\delta$.

Prove the following.

(12) $\cos(\alpha - \beta + \gamma) = \cos \alpha \cos \beta \cos \gamma$

$+ \cos \alpha \sin \beta \sin \gamma - \cos \beta \cdot \sin \alpha \sin \gamma + \cos \gamma \sin \beta \sin \alpha$.

(13) $\cos \alpha \sin(\beta - \gamma) + \cos \beta \sin(\gamma - \alpha) + \cos \gamma \sin(\alpha - \beta) = 0$.

(14) $\sin 11\alpha \sin \alpha + \sin 7\alpha \sin 3\alpha = \sin 8\alpha \sin 4\alpha$.

(15) $\dfrac{\cos \alpha + \sin \alpha}{\cos \alpha - \sin \alpha} = \sec 2\alpha + \tan 2\alpha$.

(16) If $\tan \beta = \dfrac{m \sin \alpha \cos \alpha}{1 - m \sin^2 \alpha}$,

then $\tan(\alpha - \beta) = (1 - m) \tan \alpha$.

(17) If $\tan \alpha + \tan \beta = \sec \alpha$, find the relation between α and β.

Circular Measure of Angles

28. *The length of the circumference of a circle is the limit to which the length of the perimeter of a regular polygon inscribed in the circle approaches when the number of its sides is indefinitely increased.*

Let A B C D E F be a regular polygon inscribed in a circle.

The side A B is a straight line, therefore it is shorter than any other line joining the points A and B, and therefore it is shorter than the arc A B.

$\therefore$ the perimeter of the polygon,

i.e. A B + B C + C D + D E + E F + F A, is less than the sum of the arcs A B, B C, C D, D E, E F, F A, i.e less than the circumference of the circle.

Now let each of the arcs A B, B C, etc., be bisected at a, b, c, d, e, f respectively, and let the points A a, A b, B b, B C, etc., be joined.

Then A a B b C C D d E e F f is a regular polygon with twice as many sides as A B C D E F.

Now A a + a B is greater than A B; B b + b C is greater than B C and so on.

i.e. the perimeter of A a B b C . . . . is greater than the perimeter A B C D E F.

But the perimeter of A a B b C C . . . . is less than the circumference of the circle since the straight line A a is less than the arc A a, and so on.

$\therefore$ the perimeter of A a B b C C . . . . is more nearly equal to the circumference of the circle than the perimeter of A B C D E F.

By bisecting the arcs A a, a B, B b, and so on we get a third regular polygon with twice as many

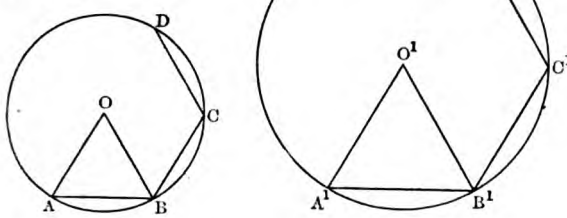
sides as the second, and the perimeter of this third polygon will be more nearly equal to the circumference of the circle than that of the second.

By continuing this process of bisection indefinitely, we obtain a regular polygon with an indefinitely great number of sides, whose perimeter differs from the length of the circumference of the circle by less than any assignable quantity.

29. *The circumference of a circle varies as its radius.*

Let O, O′ be the centres of two circles of different radii in which are inscribed the regular polygons A B C D . . . . and A′ B′ C′ D′ . . . . having the same number of sides, say n

Join O A, O B, O′ A′, O′ B′



Then angle A O B = angle A′ O′ B′ $= \frac{4 \text{ right angles.}}{n}$

Also A O : O B = A′ O′ : O′ B′

∴ the triangles A O B, A′ O′ B′ are similar

∴ A B : A′ B′ = O A : O′ A′

∴ n . A B : n A′ B′ = O A : O′ A′

∴ perimeter of polygon A B C D . . . . : perimeter of polygon A′ B′ C′ D′ . . . .

= radius O A : radius O′ A′

Now this is true whatever the number of sides in the polygons. But if n becomes infinitely great, the perimeter of each polygon in the limit = the circumference of the respective circle in which it is inscribed.

∴ circumference of circle A B C D : circumference of circle A′ B′ C′ D′

= radius O A : radius O′ A′

30. It follows from this that *the ratio of the circumference of a circle to its radius, and therefore to its diameter, is constant.*

This ratio is incommensurable and is denoted by π.

Hence if r be the length of the radius of a circle, the circumference is $2\pi r$.

The calculation of π cannot be discussed here, but it has been found to be equal to 3·141592653589793 . . . .

As a rule it is sufficient to take 5 decimal places, i.e. $\pi = 3{\cdot}14159$.

Fractions approximately equal to π are

$\frac{22}{7}$, which differs by about $\frac{1}{2500}$ from the true value,

and $\frac{355}{113}$, which differs by less than $\frac{1}{10{,}000{,}000}$ from the true value.

31. Angles are measured in three ways.

Sexagesimal Measure.

Taking the right angle as a unit, we may divide the right angle into 90 equal parts, each of which is called a **degree.** The degree is further divided into 60 equal parts, each of which is called a **minute,** and the minute is again divided into 60 equal parts, each of which is called a **second.**

An angle containing 35 degrees, 4 minutes 27 seconds is designated thus 35° 4′ 27″.

Centesimal Measure.

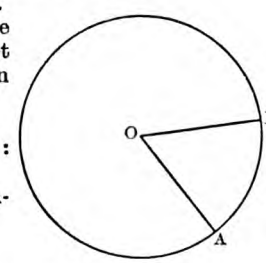
Again, the right angle, taken as a unit, may be divided into 100 equal parts, each of which is called a **grade ;** the grade is divided into 100 equal parts, each of which is called a **minute,** and the minute into 100 equal parts, each of which is called a **second.** An angle containing 85 grades 72 minutes 91 seconds is written 85ᵍ 72ᶜ 91ᶜᶜ.

Lastly, an angle may be measured by **circular measure.**

32. The unit of circular measure is the angle at the centre of a circle which stands on an arc equal in length to the radius of the circle. This angle is called a **radian.**

All radians are equal.

Let O be the centre of any circle and let A B be an arc equal in length to the radius.



Join O A, O B.

Then angle A O B : 4 right angles

= arc A B : circumference

= r : $2\pi r$

= 1 : 2π

∴ angle A O B × 2π = 4 right angles.

And since π is a constant and a right angle is a constant ∴ angle A O B is constant whatever the radius of the circle may be.

But angle A O B is a radian and hence all radians are equal.

It follows from the last equation that

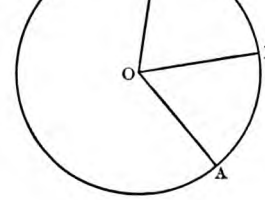
4 right angles = 2π radians

∴ 2 right angles = π radians

and 1 right angle = $\frac{\pi}{2}$ radians.

Also 1 radian $= \frac{4 \text{ right angles}}{2\pi} = \frac{2 \text{ right angles}}{\pi}$

$= \frac{180°}{3{\cdot}14159} = 57°, 17′ 45″$ approximately.



33. *The number of radians in any angle at the centre of a circle is equal to the length of the arc on which the angle stands, divided by the radius of the circle.*

Let A O C be the angle at the centre of a circle, and let A B be an arc equal in length to the radius.

Join O B.

Then angle A O B is one radian.

Angle A O C : angle A O B = arc A C : arc A B = arc A C : radius.

$$\therefore \text{ angle A O C} = \frac{\text{arc A C}}{\text{radius}} \times \text{angle A O B}$$

$$= \frac{\text{arc A C}}{\text{radius}} \times 1 \text{ radian}$$

$$\therefore \text{ the number of radians in angle A O C} = \frac{\text{arc A C}}{\text{radius}}.$$

34. Change of Units.

If D be the number of degrees, G the number of grades, and θ the number of radians in an angle according to sexagesimal, centesimal and circular measure respectively, then

$$1 \text{ degree} = \frac{1}{180} \text{ of 2 right angles}$$

$$\therefore \text{ D degrees} = \frac{D}{180} \text{ of 2 right angles}$$

$$\text{also 1 grade} = \frac{1}{200} \text{ of 2 right angles}$$

$$\therefore \text{ G grades} = \frac{G}{200} \text{ of 2 right angles}$$

$$\text{and 1 radian} = \frac{1}{\pi} \text{ of 2 right angles}$$

$$\therefore \theta \text{ radians} = \frac{\theta}{\pi} \text{ of 2 right angles.}$$

Hence, since D, G and θ are all measures of the same angle, $\frac{D}{180} = \frac{G}{200} = \frac{\theta}{\pi}$.

Examples :—

(1) Find the centesimal measure of 43°, 18′ 36″

43°, 18′ . 36″ = ·4812 of a right angle

= **48ᵍ 12′ 22″.**

(2) Find the sexagesimal measure of 79ᵍ 52′ 45″

79ᵍ 52′ 45″ = ·795245 of a right angle

= **71° 34′ 19·4″.**

(3) Find the circular measure of 22° 30′.

Let θ be the circular measure of 22° 30′, i.e. of 1350′.

$$1' = \frac{1}{180 \times 60} \text{ of 1 right angle}$$

$$\therefore 1350' = \frac{1350}{180 \times 60} \text{ of a right angle.}$$

$$\text{Also } \theta \text{ radians} = \frac{\theta}{\pi} \text{ of a right angle}$$

$$\therefore \theta = \frac{1350}{180 \times 60} \times \pi \text{ radians} = \frac{\pi}{8} \textbf{ radians.}$$

(4) Find the number of radians in 85ᵍ 50′ 20″.

Let θ be the number of radians

$$\theta = \frac{\theta}{\pi} \text{ of a right angle}$$

85ᵍ 50′ 20″ = ·85502 of a right angle

$$\therefore \theta = \textbf{·85502 } \pi \textbf{ of a right angle.}$$

(5) Find the number of degrees and the number of grades in an angle whose circular measure is $\frac{\pi}{4}$.

If D be the number of degrees

$$\frac{D}{180} = \frac{\pi}{4} \div \pi \quad \therefore D = \frac{180^\circ}{4} = \textbf{45°}$$

$$\frac{9}{200} = \frac{\pi}{4} \div \pi \quad \therefore G = \frac{200^g}{4} = \textbf{50ᵍ.}$$

(6) Find the number of seconds (sexagesimal measure) in the angle at the centre of a circle of radius one-half mile, subtended by an arc $8\frac{1}{4}$ inches long. (Take $\pi = \frac{22}{7}$.)

Let s = number of seconds in the angle.

Let θ = number of radians in the angle.

$$\theta = \frac{8\frac{1}{4}}{880 \times 36} = \frac{33}{880 \times 36 \times 4} = \frac{1}{3840}.$$

$$\text{Then } \frac{s}{180 \times 60 \times 60} = \frac{1}{3840} \div \pi$$

$$\therefore s = \frac{180 \times 60 \times 60 \times 7}{3840 \times 22} = \frac{4725}{88}$$

$$= \textbf{53}\frac{\textbf{61}}{\textbf{88}} \textbf{ seconds.}$$

Exercise 5

Find the number of degrees in the angles whose measures in radians are

(1) $\frac{\pi}{3}, \frac{\pi}{6}, \frac{\pi}{8}, \frac{3\pi}{2}, \frac{3\pi}{4}, \frac{3\pi}{8}, \frac{2\pi}{3}, \frac{2\pi}{5}$.

Express the following angles in radians

(2) 1°, 30°, 15°, 60°, 45°, 120°, 270°, 330°.

(3) Find the length of an arc which subtends an angle of 100° at the centre of a circle of radius 8 ft. (π = 3·1416.)

(4) The length of a degree on the earth's surface near the equator is 69·07 miles. Find the radius of the earth to the nearest mile.

(5) Find approximately the diameter of the sun assuming that it subtends at the earth an angle of 32′ 1″, its distance from the earth being 91 million miles. ($\pi = \frac{22}{7}$.)

(6) A railway train travels on a circular curve of two-thirds of a mile radius. Find through what angle it has turned in half a minute if it travels at the rate of 60 miles an hour. ($\pi = \frac{22}{7}$.)

Key to Exercise 3

(1) $2 - \sqrt{3}$. (2) $\frac{\sqrt{3}-1}{2\sqrt{2}}$. (3) $\frac{\sqrt{3}+1}{2\sqrt{2}}$. (6) 90°.

M. A. L.

MECHANICS.—VII

41. **Motion in a circle.**—We will consider the case of a body moving round in a circle with constant speed. There is no acceleration in the direction of its motion at any moment, yet there must be some force productive of an acceleration, which compels the body to move in a circle instead of in a straight line, for though the velocity does not change in magnitude, it changes in direction.

Suppose a particle to be moving in a circle round the centre O.

If when it is in the position P_1, the force were to cease to act, the particle would continue to move in the straight line $P_1 T_1$. In order to pursue its circular path it must have an acceleration towards the centre, i.e. perpendicular to its direction of motion $P_1 T_1$ at the moment. Such an acceleration is called a *normal* acceleration. If, then, owing to this normal acceleration, it reaches the point P_2, its direction of motion will then be $P_2 T_2$ and the same considerations hold. Hence we see that if a

body move in a circle a force must act constantly which tends to draw it towards the centre of the circle.

If you whirl a stone round by a string, the tension of the string compels the stone to move in a circle, but if the string breaks the stone will fly off in a straight line (except in so far as its path is modified by the action of gravity). The force which exerts this pull towards the centre is called **Centripetal Force.** The reaction which tends to make the stone fly away from the centre and which you feel as a pull when you hold the string attached to the whirling stone in your hand, is called **Centrifugal Force.** These two are, of course, equal and opposite. To find the magnitude of the Centripetal Force, we look upon the motion of the body as compounded of two:—namely, a uniform velocity v along the tangent to the circle and a uniform acceleration a along the radius and towards the centre.

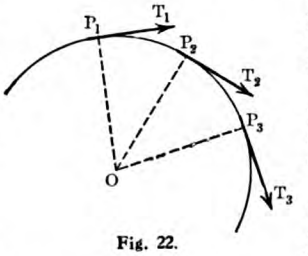


Fig. 22.

Suppose a body at P_1 be revolving counter-clockwise round the circle with centre O.

Let the uniform velocity along its path be v, and let a be the acceleration towards the centre.

Let P_1P_2 represent the part of its path described in a very small interval of time t (Fig. 23).

Then arc $P_1P_2 = vt$.

Draw PN perpendicular to OP_1. Then P_1N is the distance travelled towards the centre in time t, due to the acceleration a.

$\therefore P_1N = \frac{1}{2}at^2$

Now when t is very small indeed, arc P_1P_2 is sensibly equal to chord P_1P_2. Hence for a very small interval of time $P_1P_2 = vt$.

Now triangle P_1NP_2 and P_1P_2A are similar.

$$\therefore \frac{P_1N}{P_1P_2} = \frac{P_1P_2}{P_1A} \therefore v^2t^2 = P_1A \times \frac{1}{2}at^2$$

and if the radius of the circle be r, then

$$v^2t^2 = 2r \times \frac{1}{2}at^2 \therefore a = \frac{v^2}{r}$$

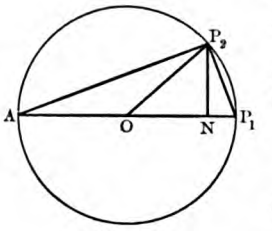


Fig. 23.

That is the acceleration towards the centre $= \frac{v^2}{r}$

Therefore the centripetal force $F = ma = \frac{mv^2}{r}$ where m = mass of the body.

Since the angular velocity $\omega = \frac{v}{r}$, we may express it thus, $F = m\omega^2 r$.

Example:—A mass of 1 lb. is whirled in a horizontal plane at the end of a string 18 inches long, and makes 3 revolutions per second. What is the tension in the string?

The tension in the string = T.

The length of one circumference is $2\pi \times \frac{3}{2}$ ft. $= 3\pi$ ft.

$\therefore v = 9\pi \frac{\text{ft}}{\text{sec}}$.

$$\therefore T = \frac{1 \times 9 \times 9\pi^2}{\frac{3}{2}} = 54\pi^2 \text{ poundals}$$

or using angular velocity: $\omega = 6\pi$

$$\therefore T = 1 \times 36\pi^2 \times \frac{3}{2} = 54\pi^2 \text{ poundals.}$$

42. *Newton formulated the law of gravity, that bodies attract one another in direct proportion to their masses and in inverse proportion to the square of their distance.*

We are here concerned with that manifestation of the force of gravity which causes all objects to move towards it, i.e. to fall. Since the mass of the earth is so much greater than that of any object on its surface, only the motion caused by the attraction of the object to the earth is perceptible to us; the motion of the earth towards the object is imperceptible.

The force pulling an object towards the earth is measured by its mass m multiplied by the acceleration g, and this is called its *weight.*

Thus $W = mg$; the weight of a body is the product of its mass and the acceleration due to gravity. This is merely a particular case of the equation $F = ma$.

The earth attracts all things towards its centre, and since the distance from the surface of the earth to its centre (about 4,000 miles) is so great, the acceleration g, due to gravity, is found to be sensibly the same at the sea level and on a mountain top. This is obvious if we remember that the force of attraction varies inversely as the square of the distance; the difference between $\frac{1}{(4{,}000)^2}$ and $\frac{1}{(4{,}001)^2}$ is not perceptible. However, owing to the fact that the earth is not a perfect sphere, and also owing to its rotation, it is found that g varies slightly in different latitudes.

43. The weights of different bodies are clearly proportional to their masses.

$$\left.\begin{array}{l}\text{For } W_1 = m_1g \\ \text{and } W_2 = m_2g\end{array}\right\} \therefore W_1 : W_2 = m_1 : m_2$$

To express the weight of a given mass in dynamical units of force.

Since $W = mg$, it is obvious that W is a force.

Now the weight of 1 lb. is unit mass multiplied by $g = 1 \times 32 = 32$ poundals

Similarly weight of 1 gm = 981 dynes.

Conversely a force of 1 poundal $= \frac{1}{32} \times$ weight of 1 lb. = weight of $\frac{1}{2}$ oz.

and a force of 1 dyne $= \frac{1}{981} \times$ weight of 1 gram.

When the force exercised by a body is measured by its weight we use what are called **gravitation units.**

The gravitation unit of force is the weight of unit mass.

Thus a "force of 1 lb." means a force equal to the weight of 1 lb.; and a "force of 3 gm" means a force equal to the weight of 3 gm.

The student is cautioned against confusing gravitation units and dynamical units of force. In practically all dynamical problems the latter must be used, and they can be expressed as gravitation units if desired, when the solution of the problem has been found.

44. Weighing by scales and by a spring balance.

When we wish to find the weight of a substance, we put it in one pan of the scales, and in the other pan we place pieces of metal whose masses are known (lb. weights, oz. weights, etc.) until the beam from which the scales hang is horizontal. Now we shall show in dealing with Statics that when this beam is horizontal, the bodies in the two pans press downwards with equal force. Since the acceleration g due to gravity is the same for each, their masses must be equal, and therefore their weights must be equal. Knowing the weight of the pieces of metal used, we thus find the weight of the body. A pair of scales really measures masses, and therefore though the value of g varies in different places, the apparent weight of the substance is the same everywhere.

When we use a spring balance, a simple form of which is given in Fig. 24, the scale is suspended from a spring which is extended by the weight of the body and the pointer shows the amount of extension on a graduated scale. This really measures the force required to stretch the spring a certain distance. The same force will always produce the same amount of stretch in the spring, but as the value of g varies at different places, the apparent weight of the body will vary slightly in different localities. In practice the variation is so slight as to be negligible.

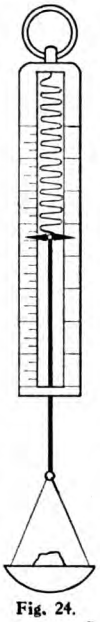


Fig. 24.

45. Atwood's Machine.

This consists essentially of a light pulley or grooved wheel (Fig. 25) fixed at a considerable height from the ground. Over the pulley passes a fine thread supporting at one end a mass P and at the other a mass Q. The groove of the pulley prevents the thread from slipping off. The axis of the pulley revolves on friction wheels (a a Fig. 25) to reduce the friction as much as possible.

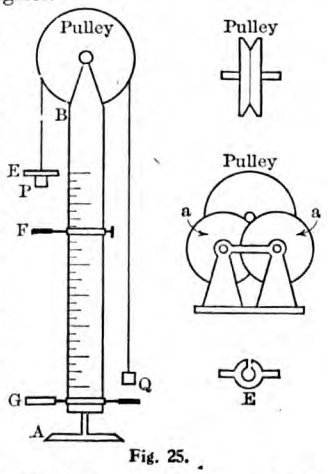


Fig. 25.

Close to the pulley is placed a pillar with a scale graduated in inches or centimetres. A pendulum or some instrument for accurately measuring time must be used with the machine.

In most experiments the masses P and Q are equal, in which case they will remain stationary or move uniformly with any velocity imparted to them. A moving force is supplied by an additional mass E (Fig. 25); the thread passes through the slot of E if it is placed on top of P. F is a ring which will allow P to pass through, but which stops E. F can be adjusted in any position on the scale by means of a screw.

Supposing P and Q are equal and in the positions indicated in Fig. 25. If E be placed on P then P and E together will descend and Q will ascend. If F is adjusted at such a distance below the starting point that P and E reach it in 1 second, then the velocity of P and E when they reach F will equal the acceleration a. Since E is left on F, P will continue to descend (and Q to ascend) with a uniform velocity equal to that acquired in reaching F. If a platform G be placed at such a distance below F that P reaches it one second after E has been removed by F, then the distance F G will measure the acceleration a. It must be borne in mind that the downward velocity and downward acceleration of P equal the upward velocity and the upward acceleration of Q respectively.

Further, the tension T of the string is the same throughout, and therefore it exerts an equal pull upwards.

Consider two masses P and Q hanging over a pulley as in Atwood's machine, (Fig. 26).

Given the mass of P $= m_1$ and the mass of Q $= m_2$. Let T be the tension in the string and a the acceleration produced supposing Q greater than P.

The forces acting on P and Q are depicted in the figure.

On P the tension T acts upwards and the weight of P $= m_1 g$ acts downwards.

On Q the tension T acts upwards and the weight of Q $= m_2 g$ acts downwards.

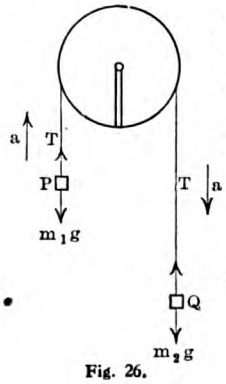


Fig. 26.

Since Q > P, Q will move downwards, and as the downward acceleration of Q is a, therefore the upward acceleration of P is a.

Since the forces acting on Q move it downwards

$$m_2 a = m_2 g - T \qquad (1)$$

And in the case of P

$$m_1 a = T - m_1 g \qquad (2)$$

To find the acceleration a

From (1) $T = m_2 (g - a)$

from (2) $T = m_1 (g + a)$

$\therefore m_2 (g - a) = m_1 (g + a)$

$$\therefore a = \frac{(m_2 - m_1)g}{m_2 + m_1}$$

To find the tension T

From (1) $a = \dfrac{m_2 g - T}{m_2}$ from (2) $a = \dfrac{T - m_1 g}{m_1}$

$$\therefore \frac{m_2 g - T}{m_2} = \frac{T - m_1 g}{m_1}$$

$$\therefore T = \frac{2 m_1 m_2 g}{m_1 + m_2}$$ dynamical units

$\therefore T = \frac{2m_1m_2}{m_1+m_2}$ gravitation units (II)

To find the force which the pulley has to support.

The string has a pull T on either side of the pulley, therefore the pulley has to support a force 2 T $= \frac{4m_1m_2}{m_1+m_2}$

46. To find the value of g by Atwood's machine.

This must be done experimentally.

Suppose the equal masses P and Q are each 15·5 oz. and the additional mass E is 1 oz. Further suppose the distance F G as described in the last paragraph is found to be 1 foot.

Now the force F which gives rise to the acceleration is the weight of the mass E. The total mass M moved is the sum of P, Q and E.

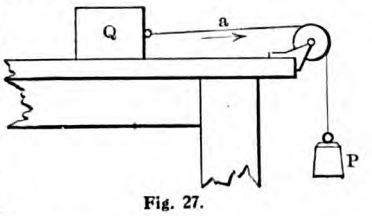


Fig. 27.

$a = \frac{\text{Force}}{\text{Mass}} = \frac{1 \cdot g}{(2 \times 15.5 + 1)} = \frac{g}{32}$

But the distance F G = 1 foot represents the acceleration in $\frac{\text{ft.}}{\text{sec.}^2}$ $\therefore a = 1$ $\therefore 1 = \frac{g}{32}$ $\therefore g = 32$

i.e. $g = 32 \ \frac{\text{ft.}}{\text{sec.}^2}$

Again suppose the mass of P is 50 grams and that of Q is 48 grams, and it is found that starting from rest P descends 40 centimetres in 2 seconds

$\because s = \frac{1}{2}at^2$ $\therefore a = \frac{2 \times 40}{4} = 20 \ \frac{\text{cm}}{\text{sec}^2}$.

but $a = \frac{m_2 - m_1}{m_2 + m_1}g$ (*see* I above)

$= \frac{50-48}{98}g$ $\therefore g = \frac{98}{2} \times 20 = 980 \ \frac{\text{cm}}{\text{sec}^2}$

Suppose a mass P of m_1 lb. hangs freely by a string and draws a mass Q of m_2 lb. along a perfectly smooth table by means of a string passing over a small pulley at the edge of the table.

Let T be the pull of the string in lb. weight.

Then the value of T in dynamical units $= Tg$ poundals.

The weight of P $= m_1g$ poundals and that of Q $= m_2g$ poundals. Let a be the acceleration in $\frac{\text{ft}}{\text{sec}^2}$.

Then $m_1a = m_1g - Tg$ (1)

$m_2a = Tg$ (2)

From (1) $T = \frac{m_1g - m_1a}{g}$; from (2) $T = \frac{m_2a}{g}$

$\therefore m_1g - m_1a = m_2a$ $\therefore a = \frac{m_1g}{m_1+m_2} \ \frac{\text{ft.}}{\text{sec}^2}$

Again from (1) $a = \frac{m_1g - Tg}{m_1}$ and from (2) $a = \frac{Tg}{m_2}$

$\therefore \frac{m_1 - T}{m_1} = \frac{T}{m_2}$ $\therefore T = \frac{m_1m_2}{m_1+m_2}$ (in lb. weight)

Suppose a mass P of m_1 lb. hangs freely by a string and draws a mass Q of m_2 lb. up a smooth inclined plane by means of a string passing over a small pulley at the top of the plane whose height is h and whose length is l.

Let T be the pull of the string in lb. weight. Then the value of T in dynamical units is Tg poundals. The weight of P $= m_1g$ poundals.

Let g' be the acceleration of Q down the plane due to its weight. Then $g' = \frac{h}{l}g$ (§ 29).

Force tending to pull Q down the plane $= m_2g' = m_2\frac{h}{l}g$.

Let a be the acceleration of Q up the plane in $\frac{\text{ft.}}{\text{sec}^2}$ and therefore also the acceleration of P downwards.

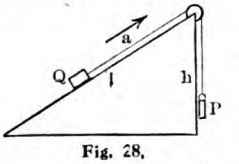


Fig. 28.

Then $m_1a = m_1g - Tg$ (1)

also $m_2a = Tg - m_2\frac{h}{l}g$ (2)

From (1) $T = \frac{m_1g - m_1a}{g}$;

from (2) $T = \frac{m_2\frac{h}{l}g + m_2a}{g}$

$\therefore m_1g - m_1a = m_2\frac{h}{l}g + m_2a$

$\therefore a = \frac{\left(m_1 - \frac{h}{l}m_2\right)g}{m_1+m_2}$

Again from (1) $a = \frac{(m_1 - T)g}{m_1}$ and

from (2) $a = \frac{\left(T - \frac{h}{l}m_2\right)g}{m_2}$

$\therefore \frac{m_1 - T}{m_1} = \frac{T - \frac{h}{l}m_2}{m_2}$ $\therefore T = \frac{m_1m_2\left(1 + \frac{h}{l}\right)}{m_1+m_2}$

$= \frac{m_1m_2(h+l)}{l(m_1+m_2)}$

Exercise 8

(1) A body of mass m strikes a second body which is at rest and whose mass is 2m. If both move forward together after impact, show that the first body loses $\frac{2}{3}$ of its velocity by impact.

(2) Two bodies whose masses are 10 lb. and 8 lb. are moving in opposite directions with velocities of 4 $\frac{\text{ft.}}{\text{sec.}}$ and 6 $\frac{\text{ft.}}{\text{sec.}}$ respectively; find the velocity and direction of motion after impact.

(3) A jet discharges 100 lb. of water per minute with a velocity of 50 $\frac{\text{ft.}}{\text{sec.}}$ perpendicularly against a wall. How much momentum is destroyed every minute by the wall and what force does the water exert upon the wall? (London Matric. Exam.)

Key to Exercise 7

(1) 60 sec. (2) 1·6 lb. (3) 50,000 dynes. (4) 10 sec.; 9 ft.

M. A. L.

Continued from page 367.

ART AND MUSIC:

***Contributors*:—THE THEORY OF ART (Hon. John Collier; J. G. B. Lynch). DRAWING AND PAINTING (J. G. B. Lynch). THE THEORY OF MUSIC (R. R. Terry, Mus.Doc., F.R.C.O.; Hubert Grant).**

WATER-COLOUR DRAWING.—I

BEFORE attempting to use colour, you will have devoted yourself for a long time to the intricacies as well as the rudiments of drawing; it is highly necessary for you always to bear in mind the enormous importance of correct and complete drawing before putting on the colour. You must get your drawing correct first; or else, once you start laying on your colours, you will make a mess of the picture if you try to alter the drawing materially.

I am using the word "drawing" above to denote pencil work only. But strictly speaking, you *draw* with your brush just as you draw with a pencil, only with a brush you draw in wide spaces and you cannot get the position of these accurate unless the guiding outlines in pencil are accurate and finished first of all.

Sketches and Studies

In water-colour drawing you speak of "sketches" and of "studies."

The difference between these two is marked. A sketch conveys to the eye a rough idea of, say, a landscape. In it all that is essential is put in, both in form and in colour. You see your landscape as a whole, as a general impression without subsidiary details. Therefore, in making a sketch it is highly important to make sure that the bold outlines, the large masses of form and colour, are quite true; a wrong angle, a false proportion, spoil the effect immediately.

A study, on the other hand, may almost be called a completed sketch. Here you have the addition of details; greater care also is given to each separate form within the borders of the whole effect. But in making a study you should be careful lest the details by over-elaboration spoil the appearance of the whole.

If you look at a landscape your first hasty impression is much the same as the appearance of a sketch. If you stop and gaze carefully your eye takes in one detail after another until what you see has the same appearance as a study.

Before continuing to say more about the general work of making sketches and studies, it is necessary to dwell for a while upon materials and their uses.

Colours and brushes have to be considered, as well as paper, a sponge, drawing boards, and pins, washleather or rag for "wiping out" lights, small receptacles for holding a quantity of mixed colour for laying on broad tints. All these things have to be thought of and their uses carefully explained.

Materials Required

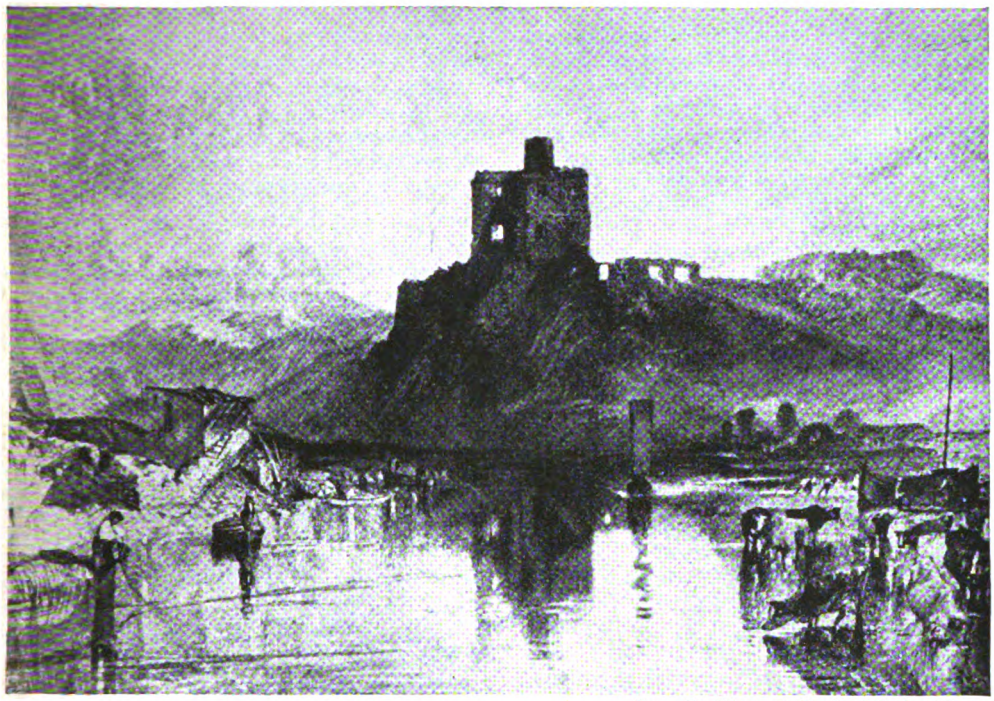
First of all by way of warning, do not embarrass yourself with too great a multitude of materials. You must have all that is likely to be necessary. But be careful not to go beyond that point. To take *colours* as the first, you must have a certain number, but it is easy and rather tempting to purchase unnecessary colours.

At the outset you should procure a japanned tin box in which the moist colours are fitted in their pans. These boxes are familiar to all. They have a white-enamelled leaf which folds over the colours inside the lid, which makes a handy palette for mixing. The lid itself has three or four concave divisions which enable you to mix a quantity of colour in separate spaces. Tin cups for holding the water can be procured which will fasten when in use to the box itself.

You should procure the following colours. yellow ochre, raw sienna, gamboge, burnt sienna, light red, brown pink, indigo, cobalt, sepia.

Of these you should have whole pans, as they are more largely required than others. Half pans of the following, however, should be got as well: cadmium yellow, Indian red, crimson lake, burnt umber, terre verte, Prussian blue, madder brown, vermilion.

You can also when necessary buy these same colours in leaden tubes, so that when the original pans are empty you can squeeze colour from the tubes into the pans as you require it.



From the Rivers of England Series, No. 23.

Norham Castle.

From the Harbours of England Series, No. 7.

North Shields.

TWO FAMOUS TURNER WATER-COLOURS.

We now come to brushes. Here as elsewhere in all relations of life, the best is most economical in the end. A cheap bad brush will hamper you in your work. There is no spring in it, the hairs will not on any occasion keep together—also they fall out constantly when laying on the colour. A bad brush often spoils a good drawing through no fault of the user. Get good brushes and you will quickly be repaid.

The brushes should be of red sable hair, which is held in tin ferrules. For the larger sizes a quill ferrule is frequently used. The sizes you are most likely to require for ordinary small drawings—that is to say, up to fifteen by ten inches—are numbers 1, 4, 6, and 8.

Questions of Paper

The paper used should be of the best ; and Whatman's, though rather expensive, fulfils all purposes in the most satisfactory manner. Many papers that will excellently serve your purpose for drawing merely with a pencil are too absorbent for water-colour. You should get fairly rough paper, which takes colour better than hot-pressed and very smooth paper. Buy an Imperial sheet and subdivide it into four or eight square parts. These will be found most convenient sizes for your purpose.

You can also buy blocks of paper bound at the edges only with a little unbound space where you can slip in your penknife after the drawing is finished and rip the sheet off. But for larger drawings it is better to fix the paper to a drawing-board for yourself. The following is the advice given by a competent authority on the subject, and as such may be here quoted in full. If you carefully follow out the rules laid down hereinafter you may be perfectly sure of obtaining a perfect surface for your first efforts in sketching :

"With a soft sponge wet both sides freely, without rubbing, lest the surface be disturbed, allow it to remain a few minutes to expand, and then turn up the edges all round about half an inch wide, and cover the edges thus turned over with stiff paste, put them down again, and place a piece of blotting-paper, folded two or three times, upon the edges, press them well down and leave them to dry ; if in the course of a few minutes it is found upon examination that the body of the paper is likely to become dry before the edges, wet the sponge again and dab it over the paper, except the pasted edges ; the object in keeping the paper damp in the middle is to secure the drying of the edges before the rest of the paper, otherwise as it contracts it will fly up.

"In re-damping the paper great care must be taken not to rub it ; the injury this would cause would soon be discovered after the colours are laid upon it, for, the surface having been destroyed, the colours would blotch, and dark irregular patches would appear, for which there is no remedy.

"If the paper is merely fixed on with drawing-pins there will be no necessity to wet it, but it should be rubbed all over gently with india-rubber before beginning the outline, as the colours will then spread more evenly.

"Upon very hard papers when the colour is first applied it runs together as though the paper were greasy, owing to the quantity of sizing and the pressure it receives in the manufacture ; the use of india-rubber will prevent this. Some artists use a medium, or preparation of oxgall, for this purpose, but we have found, if the india-rubber is carefully used, no disappointment ensues in the flow of the colours.

"If we sit too close, or bend over the drawing, we breathe upon it, and that interferes with the free spreading of the colour ; here, again, india-rubber will help us out of the difficulty."

There is little else to be said about materials, save that you should keep blotting-paper by you.

The use of the blotting-paper is for getting a fine point to your brush by drawing it backwards across the surface. Also if you have taken up too much water with your brush the blotting-paper is useful for absorbing the superfluity.

Clean Brushes

Before going on to the discussion of the use of the brush with water-colour, the student should be reminded always after using to keep his brushes clean and dry, and never to mix colours in their pans : that is, when you have taken a little gamboge and require blue to mix into a green, do not dip the brush into the gamboge and then into the blue. Take your gamboge and spread it on the palette or, if a large quantity is required, in one of your saucers, then wash your brush and dip again for the blue and then mix.

Keep your paint-box clean and do not allow too old an accumulation of colours to congregate here and there on the palette : otherwise your colouring will lose its freshness, and present a dull effect.

This, of course, would be fatal in a picture where sunlight and shadow are the chief factors. The various qualities of colour in a sunlit landscape stand out rather distinctly, and clean work is therefore most essential.

At first you will be liable to waste a good deal of colour by taking up more than is required at a time, but by degrees you will accustom yourself to guessing the amount of paint wanted for each space of tint to be laid. J. G. B. L.

Continued from page 376.

BUSINESS AND COMMERCE:

Contributors **:—BOOK-KEEPING (Frederick Heelis, F.C.I.S.). SHORTHAND (by arrangement with Pitman's Schools). COMMERCIAL TRAINING (Arthur Brooke). CHOOSING A CAREER (A. C. Marshall).**

COMMERCIAL TRAINING.—XXVII

BEFORE dismissing the questions of capital and stock as applied to the retail merchants—subjects we have dealt with in the immediately preceding lessons—point should be made of the matter of Partnership.

In the course of business it must inevitably occur that two or more men (or women) desire to set up a retail establishment together. Perhaps they have been occupied as assistants under one common employer, and each of them has specialised in some particular branch of the trade; so that, when working in unison, they should be able to form an ideal combination for the conduct of a shop of their own.

A partnership on these lines may certainly be formed where each of the partners contributes a proportion of the capital; and also agrees to devote his time and energies to the prosecution of the business. Another form of partnership would be for the buyer or buyers of an established business to enter into partnership with the former proprietor.

Partnerships

Here, the original owner would contract for a sum of money or a regular annuity or a percentage upon profits to admit a newcomer or newcomers into his business as part proprietors; and in some cases the old owner might wish to retire and to take no active part in the conduct of the business.

Again, an energetic young assistant, eager to possess a share in a business, might enter into partnership with a capitalist who would contribute the money upon fixed interest; or upon the understanding that he was to share in the profits. Such a partner is referred to as a "sleeping" or "dormant" partner.

The whole point about partnership is that each partner at the beginning makes some contribution towards the establishment of the concern. He may not be possessed of capital at all; but may offer as his share his time, work and experience. Another partner may be able to offer both money and time and experience. A third may know little or nothing about the trade, but be able to offer money.

In either event, all those who desire to become partners in a newly-established business or in the purchase of a concern of standing should meet together. By law, not more than twenty persons may constitute a partnership.

Proportionate Arrangements

At this meeting the various partners should lay upon the table, as it were, their various qualifications. One will offer his services, another capital, a third an existing interest in the business, and so on; and a definite understanding will be arrived at as to the purpose and standing of each.

Because the men are to become partners, there is no reason at all why they should share equally; for one may contribute a great deal more than others. Thus, imagining three men going into partnership, A and B may not be possessed of money, but they have knowledge and experience, and are willing to give all their time to the business for a small weekly wage. C may be a capitalist who is going to buy the business; and yet may be totally ignorant as to the trade itself.

In such a case it would be quite conceivable that the business might be divided into fifths; A and B taking one-fifth apiece, leaving C with three-fifths as his share. And, in the event of the business being afterwards disposed of, A B and C would share the proceeds in the same proportion; whilst should one of them wish to retire from the partnership, he should be able to dispose of his proportion precisely according to the preliminary arrangement.

Having settled at this meeting the exact

general terms of the partnership-to-be, the next step should be to call in the services of a solicitor, who would draw up the Articles of Partnership, to embody all the terms of the contracts agreed to at the meeting.

These Articles would show the precise liability of each partner, his share in the future profits, terms for breaking from the partnership, when cash capital is to be paid, and when services are to begin, and all such matters; and it is important that provision should be made to meet the contingency of death taking one of the partners.

Over and above the minimum capital necessary for the making of a start, there must be a liberal balance in hand to meet what may be termed working expenses.

Staff Appointments

The question of the staff needs the most earnest attention. It is only natural that men and women of experience should demand liberal wages for their services, and every retailer should arrange that he has at least one fully-trained assistant in whom he may place full confidence so that this assistant may deputise in the event of the principal's illness.

And, in the selection of a chief assistant and deputy, it is most important that the man shall, besides being an excellent business hand himself, be a sound disciplinarian, and yet a good, courteous and sympathetic chief to those beneath him in position.

The days of the bullying foreman have gone; and the employer who would obtain the greatest monetary value from his assistants is the one who sees that they are treated fairly and reasonably; that they are not underpaid; and that they are given encouragement and real, tangible prospects as the reward of faithful service.

The legal responsibility of an employer towards his assistants is very considerable; and the provisions of the Shops Act should be clearly understood. Copies of the Act are to be obtained through any bookseller, or direct from *H. M. Stationery Office, Imperial House, Kingsway, London. W.C.2.*

Briefly, the provisions of the Act include that on at least one day in each week a shop assistant shall be released from business from 1.30 p.m. onwards; and a notice must be set up in the shop showing the exact day upon which each assistant is allowed this prescribed liberty.

Intervals must be allowed to every assistant for meals; three-quarters of an hour at least being granted for dinner, and half an hour for tea. The number of hours of employment per week are also definitely fixed. Further, where girl and woman shop assistants are employed, seats must be provided in such a way that there is at least one seat for every three assistants.

Then again, every shop must be closed from 1 p.m. onwards on at least one day in every week; and the precise day of the week is usually prescribed by the local authorities, so that all the shops in a town close on the same day. This rule applies to shops in general, but there are a few exemptions, such as refreshment houses, newspaper shops and the premises on which are sold certain perishable articles. The sale of medicines is also allowed during the prohibited hours.

There are heavy penalties for those shopkeepers who break any of the laws of the Shop Acts; and everyone engaged in retail trade should make himself thoroughly conversant with their provisions.

Another legal aspect of the keeping of a retail shop concerns weights and measures; and there are Inspectors of Weights and Measures who are constantly on the alert to trace dishonest scales, measures and other appliances used in making-up the purchases of a customer.

Trade Societies

All weights and measures used in shops should bear an official stamp that they have been passed as being accurate; and from time to time an examination should be made of all such utensils to ascertain that they conform strictly to the requirements of the law.

To the honourable, straightforward retailer all these provisions of the law present no difficulties; but, at the same time, he must make himself acquainted with them, also with the purely local by-laws that govern the particular trade in which he is concerned.

In most towns there exist tradesmen's associations or tradesmen's protection societies; and, generally speaking, it is very much to the interest of the individual retailer to belong to one of these organisations.

As a member he will have the benefit of the backing of all his fellows in any trade trouble or dispute; and many of these societies arrange for the legal representation of any member who requires the services of a solicitor who has specialised in the legal work of the particular trade or calling. Moreover, there is with most of these associations a strong social side, the advantages of which are not to be overlooked. A. B.

CHOOSING A CAREER.—XXXI

In placing the profession of **Architects** next to that of Engineers we are not unmindful of the very definite connection between the two ; for in these days of steel construction, iron framework, reinforced concrete and similar developments in buildings it is absolutely necessary that the general architect shall possess some definite and practical knowledge of engineering.

The course of training usually is long and expensive. The usual plan is to begin well on the right side of twenty as an articled clerk in the office of an established architect. The articles usually run for a period of four or five years, during which time, without payment, a good deal of hard work will fall to the lot of the clerk. Moreover, he will be called upon to find a premium at the commencement of the articles, varying from £50 to £200 or even more, according to the standing and prestige of the individual or firm with whom he is serving his articles.

It stands to reason that the would-be architect should to a great extent be a born artist, and his early training must be obtained largely in art schools. And many of these art schools, particularly those under the Board of Education, offer the student a full course of tuition in freehand and geometrical drawing, in perspective, and in the theory of building construction, in preparation for examinations that will give him standing in his profession. In fact, this is an alternative method to that of serving as an articled clerk.

The examinations architects are called upon to pass in order to earn their diplomas are those of the Royal Institute of British Architects ; and an "A.R.I.B.A." is an Associate of this Institute. The examinations are three in number, preliminary, intermediate and final, and there are fees for each. Students may not enter for the second examination until they are nineteen years of age ; nor for the final until they are twenty-one.

Full details of the various examinations are to be obtained by writing to the *Secretary, Royal Institution of British Architects, Conduit Street, London, W.*1 ; and this official also supplies to applicants a list of architects who take articled clerks.

Then there is the Society of Architects, which holds examinations for those who have served for at least three years in the office of an architect. The address of the Society is *Bedford Square, London, W.C.*1.

It frequently happens that student architects enter the offices of large building contractors in order to obtain close insight into their work ; and, after the manner of engineers, architects must be possessed of keen creative ability ; and a sound knowledge of both the theoretical and the practical sides of their calling.

Architects are usually paid a percentage of the cost of the construction of the buildings they plan. Architects in consultation charge by the day. Many local authorities, municipal and otherwise, have architects upon their permanent staffs.

Surveyors are of course to be found in the employ of practically every council and municipality, and many surveyors actually graduate in the office of the local surveyors. It goes without saying that the student surveyor should have been thoroughly well educated and it will be better if, after his schooling, he is able to pass the Oxford or Cambridge Local Examination.

If he has passed this test, or some other prescribed examination, he will be excused from the preliminary examination of the Surveyors' Institution.

At the age of nineteen he may take the intermediate examination in purely professional subjects, and at twenty-one the final. Particulars of these examinations are to be obtained from the Secretary of the Institution at 12, *Great George Street, Westminster, London, S.W.* 1.

Surveyors may commence their careers in subordinate positions in the offices of practising surveyors ; and, even when they have won their certificates from the Institution by passing the examinations, probably remain in the employ of another for a few years.

For railways, waterworks, the construction of large works and buildings ; and in the management of a city or borough, there is work for surveyors and assistant surveyors, and the majority of land agents and those who have control of large estates are surveyors by profession.

The calling is a highly-interesting one, offering plenty of variety, and there should be a good future before a clever and capable young worker.

And, just as with the medical and surgical professions, so with engineering, architecture and surveying, there are scholarships to be won.

Many of the societies named offer scholarships and also money prizes to students, and the intending candidate should, by writing to the institutes, obtain the latest information concerning them. A. C. M.

BOOK-KEEPING.—XXV

In our last lesson on the passing of details of share capital to the proper books of account we had occasion to mention the subject of forfeiture of shares.

Forfeiture of Shares

Shares when forfeited may be sold by the company; that is, re-issued, but not so that the re-issue amounts to an issue at a discount.

Let us consider the following example:—

On January 1, 19.., the Directors of a Company pass a resolution forfeiting 100 Ordinary Shares of £1 each upon which a deposit of 2s. 6d. per share has been paid, but upon which 7s. 6d. due on allotment and a further call of 5s. per share remain unpaid. On the same date they re-issue the shares to James Brown, credited with 15s. per share paid up, for £70. Show in Journal form the necessary entries in the financial books of the Company.

Note that in all the Company has received 2s. 6d. per share on 100 shares, or £12 10s. + £70 cash as purchase money from James Brown = a total of £82 10s., whilst the value of the shares as credited is 15s. per share, making a total of £75. This shows a profit of £7 10s.

The student has already seen how capital is subscribed, and how the money paid on application, allotment and call is dealt with. It may be that some assets of the Company are lost or depreciate and no provision has been made. In these cases the capital is not represented by assets, and it may be necessary to *reduce* the capital. Again, the capital may be too extensive for the requirements of the business, and it thus becomes desirable and proper to return some portion to the shareholders.

Reducing Capital

In the first kind of reduction we have merely a matter of book-keeping, but in the second an actual repayment of cash is involved.

Thus, for example, on account of heavy losses the Directors of a Limited Company obtain power to reduce the capital from 100,000 shares of £1 each, ten shillings per share paid up, to 100,000 shares of 5s. per share, each fully paid. State what entries in the financial books are necessary to give effect to this. Note what the effect is. Ten shillings per share is still due, but the Directors have obtained power to forgo the calls. Further, the ten shillings already paid is to be considered as only worth five shillings. The first part, forgoing the right to make calls, affects creditors and the Court must sanction it. The second part is also sanctioned but it is a matter of paper; since every £1 share is to be considered as a 5s. share each shareholder's holding is reduced in the same proportion, and on dissolution the surplus assets are divisible in proportion to the value of shares held.

JOURNAL

19..				£	s.	d.	£	s.	d.
Jan.	1	Forfeited Shares Account .. .. *Dr.*		75	–	–			
		To Cash paid on Forfeited Shares Account					12	10	–
		„ Allotment Account					37	10	–
		„ First Call Account					25	–	–
		For forfeiture this day as per resolution of the Board: 100 Ordinary Shares standing in the name of..... on which 15s. per share had been called up, but only 2s. 6d. per share received by the Company. Shares numbered ..... to ..... inclusive.							
Jan.	1	Cash .. .. *Dr.*		70	–	–			
		Cash paid on Forfeited Shares Account .. .. *Dr.*		5	–	–			
		To Forfeited Shares Account being 100 Ordinary Shares numbered ..... to ..... inclusive, re-issued to Mr. James Brown for a cash payment of £70, but credited with 15s. per share paid up as per resolution of the Board.					75	–	–

The above entries can be posted to the Ledger by the student who has understood the previous lessons. It will be noted that the Cash paid on forfeited shares account will show a balance of £7 10s. The forfeited shares account will be closed. This profit of £7 10s. is not divisible profit, and will be kept as a reserve or used for the writing off of assets which the company is not legally obliged to write off, e.g. fictitious assets and goodwill.

The proper entries in the books will be as follows, supposing that the deficiency on the Profit and Loss Account reaches the sum of £28,000:—

If capital is returned to the shareholders, consent of the Court is required, and the entries would be :—

Share Capital Account *Dr.*——
To Cash .. .. *Cr.* ——

This would be followed by the narrative statement showing the authority for the Company the liability " Capital " takes first place since it is always recognised that the Balance Sheet should give both nominal and subscribed capital, as in the example at the foot of this page.

Then follow Debentures, Interest on Debentures. Unpaid Dividends (if any), Sundry Creditors, Reserves, etc.

JOURNAL

		£	s.	d.	£	s.	d.
	Share Capital Account .. .. *Dr.*	25,000	--	–			
	To Profit and Loss Account				25,000	–	–
	Being a reduction of the capital of the Company in accordance with a resolution passed by the Shareholders at a Meeting held on the.....day of ..... 19.., and subsequently confirmed by the Court under an order dated.....day of.....19.., sanctioning such reduction and authorising the writing down of the deficiency of the Profit and Loss Account to £3,000.						

Cr.

LEDGER

Dr. SHARE CAPITAL ACCOUNT *Cr.*

	£	s.	d.		£	s.	d.
To Profit and Loss Account	25,000	–	–	By Cash	50,000	–	–
,, Cash Balance c/d	25,000	–	–				
	£50,000	–	–		£50,000	–	–

Dr. PROFIT AND LOSS ACCOUNT *Cr.*

	£	s.	d.		£	s.	d.
To Balance b/d ..	28,000	–	–	By Share Capital Account ..	25,000	–	–
				,, Balance c/d ..	3,000	–	–
	£28,000	–	–		£28,000	–	–
To Balance b/d ..	£3,000	–	–				

reduction and the return of £— to the shareholders. The share ledger will contain a note of the effect on individual shareholders. Share Certificates will be called in and indorsed with particulars.

Increase of Capital.—A Company may increase its capital by special resolution, provided it has taken power to do so in its Articles of Association. The entries relating to the increase will be identical with those of the first issue.

Arrangement of Items in a Company's Balance Sheet. We have already seen the general arrangement of the items in the Balance Sheet. In the case of a Limited Company the liability " Capital " takes first place since it is always recognised that the Balance Sheet should give both nominal and subscribed capital, as in the example at the foot of this page.

Then follow Debentures, Interest on Debentures. Unpaid Dividends (if any), Sundry Creditors, Reserves, etc.

The question of Reserves will be discussed more fully in a later lesson. For the remainder of the present lesson we will devote ourselves to the method of treatment of the balance of Profit and Loss Account.

Against this, if a credit balance we have the following debits :—

	LIABILITIES	£	s.	d.	£	s.	d.
	Nominal Capital 100,000 Ordinary Shares of £1 each ..	100,000	–	–			
	Issued Capital, 60,000 Ordinary Shares of £1 each, 10s. called up	30,000	–	–			
	Less calls in arrear	400	–	–	29,600	–	–

(*a*) Such Directors' Fees as may be voted unless they are fixed by the Articles of Association, in which case they are ordinary liabilities of the Company. The amount will be credited to Directors' Fees Account.

(*b*) Amounts carried to reserve, and in certain cases to Sinking Funds. This will be dealt with subsequently.

(*c*) Dividends payable to Shareholders, either at a fixed rate on Preference Shares or as voted on Ordinary Shares. Dividends Account will be credited.

Although the details of the appropriation of the credit balance from the Profit and Loss Account are, as a rule, shown in the Balance Sheet, it is customary to open a Profit and Loss Appropriation Account, e.g.

Dr. PROFIT AND LOSS APPROPRIATION ACCOUNT *Cr.*

19..		£	s.	d.	19..		£	s.	d.
Jan. 5	To Directors' Fees ..	2,000	–	–	Dec. 31	By Profit and Loss Account	30,000	–	–
	,, Reserve Fund ..	4,000	–	–					
	,, Dividends Account 5 per cent. on £120,000 Pref. Shares	6,000	–	–					
	12 per cent. on £100,000 Ord. Shares	12,000	–	–					
	,, Balance c/d ..	6,000	–	–					
		£30,000	–	–			£30,000	–	–
					19.. Jan. 5	By Balance b/d ..	£6,000	–	–

Dr. DIVIDENDS ACCOUNT *Cr.*

19..		£	s.	d.	19..		£	s.	d.
Jan. 30	To Income Tax a/c	1,500	–	–	Jan. 5	By Profit and Loss Appropriation a/c 5 per cent. on £120,000 Pref. Shares	6,000	–	–
	,, Bank for Dividends a/c..	16,500	–	–		12 per cent. on £100,000 Ord. Shares	12,000	–	–
		£18,000	–	–			£18,000	–	–

The Dividends Account is balanced by debiting it with (I) Cash in Bank, and crediting Bank, and (II) Income Tax which is deducted. Rent, Rates and Taxes Account or Income Tax Account is credited. If the Company is a large one, as in the above example, it would be well to keep the various payments out of the Cash Book by opening a Dividends Account at the Bank, transferring enough to meet the Dividend Warrants issued.

The Journal entries will be quite simple.

Profit and Loss Appropriation Account .. *Dr.*——
To Dividends Account ——

An *Interim* Dividend is treated exactly in the same way. The narrative in the Journal will state the authority for payment.

Definition of Terms

Demurrage.—A charge made by the owner of a vessel for its detention beyond a stipulated time. The charge is generally a certain amount per day. The term is also applied to the charge made by railway companies for the retention of wagons and trucks.

Exercise

1. The A. Company, Limited, having a Nominal Capital of £100,000 in Shares of £1 each, has issued 65,000 Shares, upon each of which 15s. has been called up. Holders of 5,000 Shares have, however, paid up in full in advance of Calls, while the last call of 5s. per Share remains unpaid in the case of 1,250 Shares, and 50 Shares have been forfeited for non-payment of the amount due on allotment, a deposit of 2s. 6d. per share on application having alone been received thereon.

You are required to show the form in which these facts would be stated in the Balance Sheet of the Company.

2. State, in Journal form, the entries necessary to record the forfeiture of Shares referred to in the preceding question, and add such further entries as would be necessary to record their re-issue at par, with 15s. per Share called up and received in cash on allotment.

(Chartered Institute of Secretaries.)

F. H.

Continued from page 381.

ENGLISH LANGUAGE AND LITERATURE:

***Contributors*:**—ENGLISH LANGUAGE (W. A. Craigie, M.A., LL.D.; E. W. Edmunds, M.A.). ENGLISH LITERATURE (John Derry, J.P.). PHILOSOPHY (E. H. Tripp, Ph.D.). POLITICAL ECONOMY (J. W. Urwin). ETHICS (W. H. Koebel). PUBLIC SPEAKING (J. W. Urwin).

PHILOSOPHY.—VIII

ACCORDING to Ostwald, he essential characteristics of living organisms are their *stationary* nature, their capacity for self-acquisition of nourishment, and their power of reproduction.

Stationary Objects

To illustrate what is understood by a stationary as distinct from a stable body, he instances a brass tap through which water is flowing. The tap itself is a stable object because it is at rest in all its parts, it remains the same for an indefinite time. The jet of water issuing from it is a stationary object; its outer form remains constant but the particles of water which compose it are not the same two seconds together; its parts are interchangeable.

If the tap be scratched, the mark remains, but if the water jet be cut into or severed, the lesion is repaired or healed at once owing to the continuous flow of the water. Organisms are stationary bodies in the same sense, and they exhibit the same capacity for healing or for being regenerated. Such regeneration is due to the changes (called " metabolism ") taking place within it, and for these changes to take place it is imperative that the organism should lay up a store of energy in the form of food, and that it should be able to acquire that food by its own efforts, otherwise it would die. The changes which take place in a stationary lifeless object, such as a gas-flame, do not conduce to its further existence, but to the contrary; the changes within the organism tend to preserve it.

The organism is like a gas-flame that has the power to supply itself with more gas. Allied to this power of self-nourishment is that of reproduction; just as the former leads to the preservation of the individual, the latter promotes the preservation of the race. The period of duration of a water-jet or of a gas-flame is limited, and the days of the living organism are likewise numbered; but whereas the stationary lifeless object leaves behind nothing to perpetuate it, the stationary living object continues to live in its offspring. These three properties mentioned, then, are essential characteristics of living organisms: and what is true of the organism as a whole is also true of its parts, the cells. A living cell is a stationary body with the power of regeneration; it obtains nourishment from the circumambient medium in which it exists, and it reproduces its kind by subdivision or by budding.

Living and Non-Living

In summing up the evidence for and against the main thesis that the terms living and non-living connote a real difference, it may be said that that difference is most marked in the chemical composition of the material of which the objects are composed: that the other differences are of degree rather than of kind: that no one of these other differences constitutes an absolute criterion in itself, but taken *en masse* they afford a cumulative proof that the verbal distinction reflects an actual difference.

At the same time, there is no evidence to show that the so-called forces which operate in and around lifeless objects are in any way different in kind from those which are operative in living organisms. The doctrine of " Vitalism "—that there is a special kind of force which is peculiar to living matter—has been discarded by the great majority of physiologists, who see in it not merely a cloak of ignorance but an attempt to explain " *obscurum per obscurius.*" The principle of " Occam's razor " (i.e. assumptions should be reduced to a minimum) is one of the

safest to pursue; it is therefore unwise to assume the existence of a specific "vital" force.

Admitting, then, the distinction *de facto* as well as *de verbo*, and the consequent improbability of hylozoism, we have to inquire into the merits of neo-animism, i.e., whether psychical phenomena *always* accompany physical phenomena, whether matter is *always* the vehicle of mind, both **(a)** in the living world and (*b*) in the non-living world.

It is no easy matter to form judgments concerning the mentality even of man and of animals akin to man. Our most certain knowledge is that of our self-consciousness of our own existence, and related thereto is the knowledge obtained directly through the medium of our sensatory organs; all other knowledge is inferred, deduced from observations, and as such must be less certain.

Some of our knowledge is so highly probable that for all practical purposes it may be regarded as true and certain. Our knowledge of the mental states of living beings is inferred from their gestures, their speech and their general behaviour: the sole standard by which we can judge them is that of our own mental states; we eject or *read into* their minds what we experience in our own.

Reflex Actions

We do not experience much difficulty, as a rule, in coming to conclusions about the mentality of our fellow beings, but the conclusions become more and more hazardous and liable to error the more the organisation of the living being differs from our own; and even in cases where the being is of a highly developed order, our inferences are very liable to be wrong. We accidentally tread upon the foot of a dog; it makes off yelping dismally. Our inference that the dog has been hurt, i.e. that he has the feeling of pain, we regard as most probably true, but we may be making a great mistake if we think that the quality and quantity of the animal's sensation is the same as, or commensurable with, that which we should experience under like circumstances.

To take another case, if a drop of acetic acid be put on the side of the body of a frog, it will show all the symptoms of pain. If now the spinal cord be severed so that neural communication between the spot and the brain be cut off, and the acid be again applied, the frog will lift up his leg and use his foot to rub the acid off. If that limb be held, he will use his other leg to effect the same purpose. There can be little doubt in this case that there is no question of consciousness—yet the frog behaves as if it were fully conscious.

Such movements of an organism as are conditioned by the activity of the nerves without the co-operation of the conscious centres of the brain, are called *reflex* actions; but, normally, the sensory nerves transmit impulses from without to the brain, and there evoke consciousness. Wherever we find a nervous system associated with a central organ, we believe that the organism has consciousness, or the possibility of it, but where that brain and nervous system are lacking we have no right to infer consciousness; it may be that it exists but we have no means of finding out; and innumerable living organisms are known which do not possess these structures essential to consciousness.

If then we are debarred from ascribing consciousness, as we know it, to beings which are undoubtedly living, how much more are we debarred from affirming it in objects which are undoubtedly lifeless? And if there is no evidence from physiology to warrant the belief in neo-animism, is there evidence of another kind? We opine not.

The only basis for the hypothesis is that it harmonises with the negative principle of psycho-physical parallelism that mind and body, spirit and matter, do not interact. That principle helps to smooth over some of the points of contention between materialism and spiritualism; it derives sustenance from that physiological view which regards all living organisms as automata; and it removes all difficulty in connection with the law of the conservation of energy; it and its correlative doctrines, hylozoism and neo-animism, are interesting, seductive, poetical, and imaginatively fertile, after the manner of useful hypotheses, but when arraigned at the bar of experience they can but receive the unsatisfactory verdict of "not proven."

Summary of Lesson VI

Psycho-physical Parallelism. Physical and mental phenomena are causally related in the sense laid down in Lesson V, but there is no enforcement or necessity in the relation.

The consciousness of our power to move our limbs, etc., and to influence the motion of external objects, has been elaborated to such an extent that "will" has been "read into" all parts of nature, and has been regarded as the essential principle of all things.

Psycho-physical parallelism denies any interaction between mind and matter and affirms that

physical and psychical events proceed in separate series.

The denial of interaction is largely based upon its alleged incompatibility with the law of the conservation of energy.

Huxley thought that external phenomena acted upon consciousness, but that the latter had no influence upon the former. Hence men and animals were conscious automata.

The view that to every physical event there is a corresponding mental element ("neo-animism") involves, in the case of neurosis and psychosis, the necessity of assuming the existence of various unknown mental phenomena.

Neo-animism is closely related to Hylozoism, the doctrine that all matter is the seat of some form of life.

Summary of Lesson VII

The boundary line between living and non-living is ill-defined, and the ultimate chemical constituents of both are identical. Neither of these facts invalidates the view that there is an essential difference between them.

As the attempted definitions of life are all in some respects unsatisfactory, description must be substituted for definition.

Such suggested criteria of life as spontaneous movement, irritability, growth, structure, morphology (form), and development, can all be artificially imitated with inorganic materials.

The most satisfactory criterion is found in the chemical composition of living matter.

The phenomena of life in its simplest manifestations are the phenomena of protoplasm. This highly complex material doubtless originated —and perhaps still originates—from non-living matter; its synthesis by man is not inherently impossible, but probably very remote.

Summary of Lesson VIII

The essential characteristics of living organisms are, their stationary nature, their property of recuperation, and their power of reproduction.

The explanation of life in terms of "vital force" is rejected by physiology, and is an example of explanation *obscurum per obscurius*.

The available evidence leads to the conclusion that the terms "living" and "lifeless" are justified as applied to natural objects.

The principle of "Occam's razor," that entities are not to be multiplied (i.e. that assumptions should be reduced to a minimum) is one of the safest to pursue in all provinces of philosophical inquiry.

Our knowledge of the mentality of living beings is seldom certain and becomes increasingly uncertain as their organisation differs from our own.

We may easily err in ascribing consciousness even to animals endowed with brain and nervous system, and there is no evidence that anything akin to human consciousness exists in organisms devoid of them.

Neo-animism is an attempt to deduce experience from thought, the argument starting with the assumption of the non-interaction of mind and matter.

As a "working hypothesis" psycho-physical parallelism may be "useful," but it cannot on that account be claimed to be "true." E. H. T.

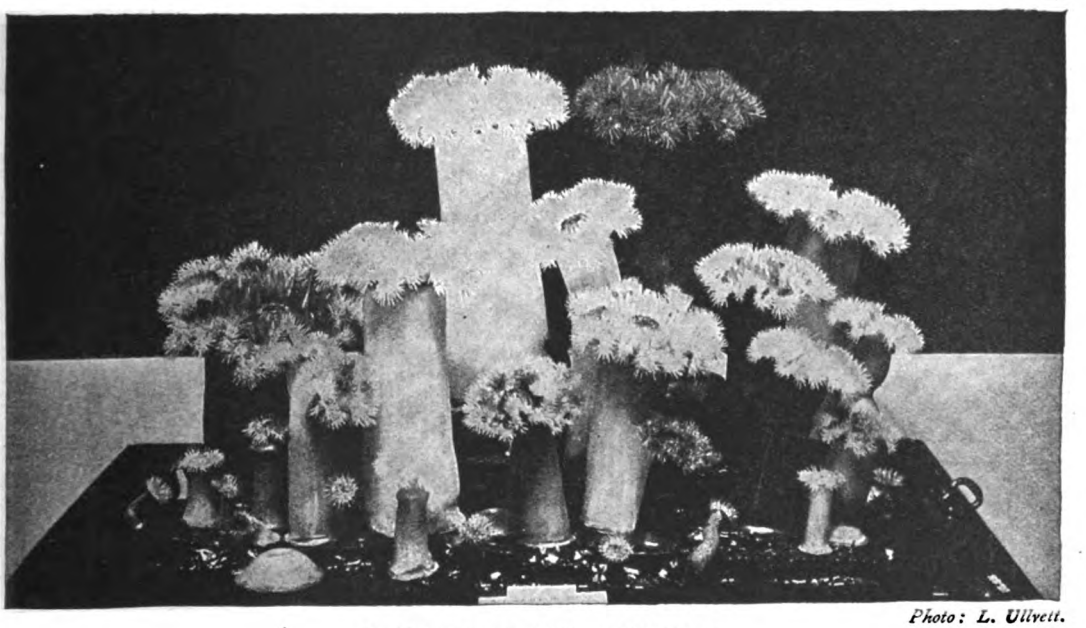
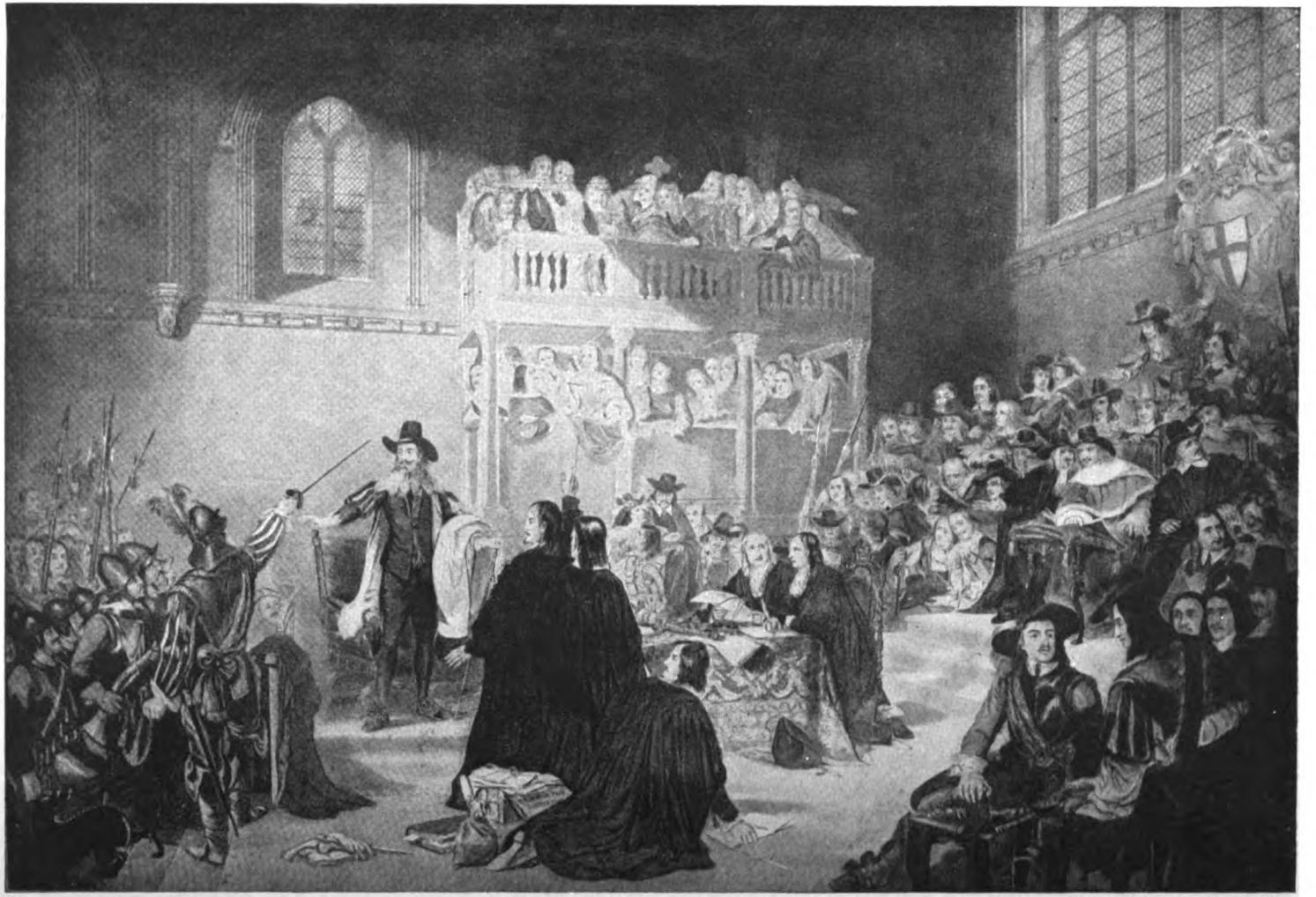


Photo: L. Ullvett.

A GROUP OF SEA ANEMONES

which, although representative of a very low form of life, are alive not in the sense in which plants are alive, but as animals are alive.



From the picture by W. Fisk

THE TRIAL OF CHARLES I.

was held publicly in Westminster Hall. One hundred and thirty-five judges had been named, but only eighty (including Cromwell) attended the sittings of the Court. Bradshaw, Cromwell's cousin, presided. The King, who refused to answer the charges, was found guilty of trying to overturn the liberties of the people and of being a murderer, traitor and tyrant.

Continued from page 390.

HISTORY:

Contributors:—J. A. Brendon, B.A.(Oxon.), F.R.Hist.S.; F. Collinson, F.R.Hist.S.; T. P. Evans, B.A.(Oxon.); James A. Manson; L. Stampa, M.A.(Oxon.); and J. B. Sterndale-Bennett.

BRITAIN'S STORY.—XV

[*The introductory chapter to* LORD MACAULAY'S *"History of England" has been adopted in this work to explain the development of the British race prior to* 1660. *But as Lord Macaulay's work was intended merely as a sketch, explanatory passages (printed in closer type) have been interpolated in order to meet the requirements of the student.*]

One of Cromwell's chief difficulties was to restrain his musketeers and dragoons from invading by main force the pulpits of ministers whose discourses, to use the language of that time, were not savoury; and too many of our cathedrals still bear the marks of the hatred with which those stern spirits regarded every vestige of Popery.

To keep down the English people was no light task even for that army. No sooner was the first pressure of military tyranny felt, than the nation, unbroken to such servitude, began to struggle fiercely. Insurrections broke out even in those counties which, during the recent war, had been the most submissive to the Parliament.

Cromwell's Difficulties

Indeed, the Parliament itself abhorred its old defenders more than its old enemies, and was desirous to come to terms of accommodation with Charles at the expense of the troops. In Scotland at the same time, a coalition was formed between the Royalists and a large body of Presbyterians who regarded the doctrines of the Independents with detestation.

At length the storm burst. There were risings in Norfolk, Suffolk, Essex, Kent, Wales. The fleet in the Thames suddenly hoisted the royal colours, stood out to sea, and menaced the southern coast. A great Scottish force crossed the frontier and advanced into Lancashire. It might well be suspected that these movements were contemplated with secret complacency by a majority both of the Lords and of the Commons.

But the yoke of the army was not to be so shaken off. While Fairfax suppressed the risings in the neighbourhood of the capital, Oliver routed the Welsh insurgents, and, leaving their castles in ruins, marched against the Scots. His troops were few, when compared with the invaders; but he was little in the habit of counting his enemies. The Scottish army was utterly destroyed. A change in the Scottish government followed. An administration, hostile to the King, was formed at Edinburgh; and Cromwell, more than ever the darling of his soldiers, returned in triumph to London.

The King in Danger

And now a design, to which, at the commencement of the civil war, no man would have dared to allude, and which was not less inconsistent with the Solemn League and Covenant than with the old law of England, began to take a distinct form. The austere warriors who ruled the nation had, during some months, meditated a fearful vengeance on the captive King.

When and how the scheme originated; whether it spread from the general to the ranks, or from the ranks to the general; whether it is to be ascribed to policy using fanaticism as a tool, or to fanaticism bearing down policy with headlong impulse, are questions which, even at this day, cannot be answered with perfect confidence. It seems, however, on the whole, probable that he who seemed to lead was really forced to follow, and that, on this occasion, as on another great occasion a few years later, he sacrificed his own judgment and his own inclinations to the wishes of the army.

The power which he had called into existence was a power which even he could not always control; and, that he might ordinarily command, it was necessary that he should sometimes obey. He publicly

Tower of London.

Cuirassier of the seventeenth century.

protested that he was no mover in the matter, that the first steps had been taken without his privity, that he could not advise the Parliament to strike the blow, but that he submitted his own feelings to the force of circumstances which seemed to him to indicate the purposes of Providence.

It has been the fashion to consider these professions as instances of the hypocrisy which is vulgarly imputed to him. But even those who pronounce him a hypocrite will scarcely venture to call him a fool.

He was far too wise a man not to know, when he consented to shed that august blood, that he was doing a deed which was inexpiable, and which would move the grief and horror, not only of the Royalists, but of nine-tenths of those who had stood by the Parliament. Whatever visions may have deluded others, he was assuredly dreaming neither of a republic on the antique pattern, nor of the millennial reign of the Saints.

If he already aspired to be himself the founder of a new dynasty, it was plain that Charles I. was a less formidable competitor than Charles II. would be. At the moment of the death of Charles I. the loyalty of every Cavalier would be transferred, unimpaired, to Charles II. Charles I. was a captive: Charles II. would be at liberty. Charles I. was an object of suspicion and dislike to a large proportion of those who yet shuddered at the thought of slaying him: Charles II. would excite all the interest which belongs to distressed youth and innocence.

It is impossible to believe that considerations so obvious, and so important, escaped the most profound politician of that age. The truth is that Cromwell had, at one time, meant to mediate between the throne and the Parliament, and to reorganise the distracted State by the power of the sword, under the sanction of the royal name. In this design he persisted till he was compelled to abandon it by the refractory temper of the soldiers, and by the incurable duplicity of the King.

The vices of Charles had grown upon him. They were, indeed, vices which difficulties and perplexities generally bring out in the strongest light. Cunning is the natural defence of the weak. A prince, therefore, who is habitually a deceiver when at the height of power, is not likely to learn frankness in the midst of embarrassments and distresses.

Charles was not only a most unscrupulous but a most unlucky dissembler. There never was a politician to whom so many frauds and falsehoods were brought home by undeniable evidence. He publicly recognised the Houses at Westminster as a legal Parliament, and, at the same time, made a private minute in council declaring the recognition null. He publicly disclaimed all thought of calling in foreign aid against his people: he privately solicited aid from France, from Denmark, and from Lorraine. He publicly denied that he employed Papists; at the same time he privately sent to his generals directions to employ every Papist that would serve.

Cromwell and Charles

He publicly took the sacrament at Oxford, as a pledge that he never would even connive at Popery. He privately assured his wife that he intended to tolerate Popery in England; and he authorised Lord Glamorgan to promise that Popery should be established in Ireland. Then he attempted to clear himself at his agent's expense. Glamorgan received, in the Royal handwriting, reprimands intended to be read by others, and eulogies which were to be seen only by himself. To such an extent, indeed, had insincerity now tainted the King's whole nature, that his most devoted friends could not refrain from complaining to each other, with bitter grief and shame, of his crooked politics. His defeats, they said, gave them less pain than his intrigues. Since he had been a prisoner, there was no section of the victorious party which had not been the object both of his flatteries and of his machinations: but never was he more unfortunate than when he attempted at once to cajole and to undermine Cromwell.

Cromwell had to determine whether he would put to hazard the attachment of his party, the attachment of his army, his own greatness, nay, his own life, in an attempt which would probably have been vain, to

save a prince whom no engagement could bind. With many struggles and misgivings, and probably not without many prayers, the decision was made. Charles was left to his fate. The military saints resolved that, in defiance of the old laws of the realm, and of the almost universal sentiment of the nation, the King should expiate his crimes with his blood.

He for a time expected a death like that of his unhappy predecessors, Edward II and Richard II. But he was in no danger of such treason. Those who had him in their grips were not midnight stabbers. What they did they did in order that it might be a spectacle to heaven and earth, and that it might be held in everlasting remembrance. They enjoyed keenly the very scandal which they gave. That the ancient constitution and the public opinion of England were directly opposed to regicide made regicide seem strangely fascinating to a party bent on effecting a complete political and social revolution.

Execution of Charles I

In order to accomplish their purpose, it was necessary that they should first break in pieces every part of the machinery of the government; and this necessity was rather agreeable than painful to them.

The Commons passed a vote tending to accommodation with the King. The soldiers excluded the majority by force. The Lords unanimously rejected the proposition that the King should be brought to trial. Their house was instantly closed. No court, known to law, would take on itself the office of judging the fountain of justice. A revolutionary tribunal was created. That tribunal pronounced Charles a tyrant, a traitor, a murderer, and a public enemy; and his head was severed from his shoulders, before thousands of spectators, in front of the banqueting hall of his own palace.

The execution of Charles I was not only a crime, but an error. The zealots responsible for its committal gave to a prince, hitherto known to his people chiefly by his faults, an opportunity of displaying, on a great theatre, before the eyes of all nations and all ages, some qualities which irresistibly call forth the admiration and love of mankind, the high spirit of a gallant gentleman, the patience and meekness of a penitent Christian. Nay, they had so contrived their revenge that the very man whose life had been a series of attacks on the liberties of England now seemed to die a martyr in the cause of those liberties.

No demagogue ever produced such an impression on the public mind as the captive King, who, retaining in that extremity all his regal dignity, and confronting death with dauntless courage, gave utterance to the feelings of his oppressed people, manfully refused to plead before a court unknown to the law, appealed from military violence to the principles of the constitution, asked by what right the House of Commons had been purged of its most respectable members and the House of Lords deprived of its legislative functions, and told his weeping hearers that he was defending, not only his own cause, but theirs. His long misgovernment, his innumerable perfidies, were forgotten. His memory was, in the minds of the great majority of his subjects, associated with those free institutions which he had, during many years, laboured to destroy: for those free institutions had perished with him, and, amidst the mournful silence of a community kept down by arms, had been defended by his voice alone.

From that day began a reaction in favour of monarchy and of the exiled house, a reaction which never ceased till the throne had again been set up in all its old dignity.

At first, however, the slayers of the King seemed to have derived new energy from that sacrament of blood by which they had bound themselves closely together, and separated themselves for ever from the great body of their countrymen. England was declared a commonwealth. The House of Commons, reduced to a small number of members, was nominally the supreme power in the state. In fact, the army and its great chief governed everything.

Rotunda Museum, Woolwich.

Pikeman of the seventeenth century.

Oliver had made his choice. He had kept the hearts of his soldiers, and had broken with almost every other class of his fellow citizens. Beyond the limits of his camps and fortresses he could scarcely be said to have a party. Those elements of force which, when the civil war broke out, had appeared arrayed against each other, were combined against him ; all the Cavaliers, the great majority of the Roundheads, the Anglican Church, the Presbyterian Church, the Roman Catholic Church, England, Scotland, Ireland. Yet such was his genius and resolution that he was able to overpower and crush everything that crossed his path, to make himself more absolute master of his country than any of her legitimate Kings had been, and to make his country more dreaded and respected than she had been during many generations under the rule of her legitimate Kings.

England had already ceased to struggle. But the two other kingdoms which had been governed by the Stuarts were hostile to the new republic. The Independent party was equally odious to the Roman Catholics of Ireland and to the Presbyterians of Scotland. Both those countries, lately in rebellion against Charles I, now acknowledged the authority of Charles II.

But everything yielded to the vigour and ability of Cromwell. In a few months he subjugated Ireland, as Ireland had never been subjugated since the landing of the first Norman settlers.

Scotland and the Stuarts

From Ireland the victorious chief, who was now in name, as he had long been in reality, Lord General of the armies of the Commonwealth, turned to Scotland. The young King was there. He had consented to profess himself a Presbyterian, and to subscribe the Covenant ; and, in return for these concessions, the austere Puritans who bore sway at Edinburgh had permitted him to assume the crown, and to hold, under their inspection and control, a solemn and melancholy court.

This mock royalty was of short duration. In two great battles Cromwell annihilated the military force of Scotland. Charles fled for his life, and, with extreme difficulty, escaped the fate of his father.

The ancient kingdom of the Stuarts was reduced, for the first time, to profound submission. Of that independence, so manfully defended against the mightiest and ablest of the Plantagenets, no vestige was left. The English Parliament made laws for Scotland. English judges held assizes in Scotland. Even that stubborn Church, which has held its own against so many governments, scarce dared to utter an audible murmur.

Thus far there had been at least the semblance of harmony between the warriors who had subjugated Ireland and Scotland and the politicians who sat at Westminster : but the queasy alliance which had been cemented by danger was dissolved by victory. The Parliament forgot that it was but the creature of the army. The army was less disposed than ever to submit to the dictation of the Parliament. Indeed, the few members who made up what was contemptuously called the Rump of the House of Commons had no more claim than the military chiefs to be esteemed as the representatives of the nation.

Lord High Protector

The dispute was soon brought to a decisive issue. Cromwell filled the House with armed men. The Speaker was pulled out of his chair, the mace taken from the table, the room cleared, and the door locked. The nation, which loved neither of the contending parties, but which was forced, in its own despite, to respect the capacity and resolution of the General, looked on with patience, if not with complacency.

King, Lords, and Commons, had now in turn been vanquished and destroyed ; and Cromwell seemed to be left the sole heir of the powers of all three. Yet were certain limitations still imposed on him by the very army to which he owed his immense authority.

That singular body of men was, for the most part, composed of zealous republicans. In the act of enslaving their country, they had deceived themselves into the belief that they were emancipating her. The book which they most venerated furnished them with a precedent which was frequently in their mouths. It was true that the ignorant and ungrateful nation murmured against its deliverers. Even so had another chosen nation murmured against the leader who brought it, by painful and dreary paths, from the house of bondage to the land flowing with milk and honey. Yet had that leader rescued his brethren in spite of themselves ; nor had he shrunk from making terrible examples of those who contemned the proffered freedom, and pined for the fleshpots, the taskmasters, and the idolatries of Egypt.

The object of the warlike saints who surrounded Cromwell was the settlement of a free and pious commonwealth. For that end

Drawn by R. Caton Woodville, R.I.

THE INSTALLATION OF OLIVER CROMWELL AS LORD PROTECTOR, JUNE 26TH, 1657.

The ceremony was performed with all the pomp and splendour of a royal coronation save that it was conducted at Westminster Hall instead of at Westminster Abbey; whence, for the only time in its history, St. Edward's chair was moved for the occasion. Above, Mr. Speaker is seen, at the close of the ceremony, presenting a Bible to the Lord Protector, on whose left stands the Lord Mayor, and on whose right the Ambassadors of France and Holland.

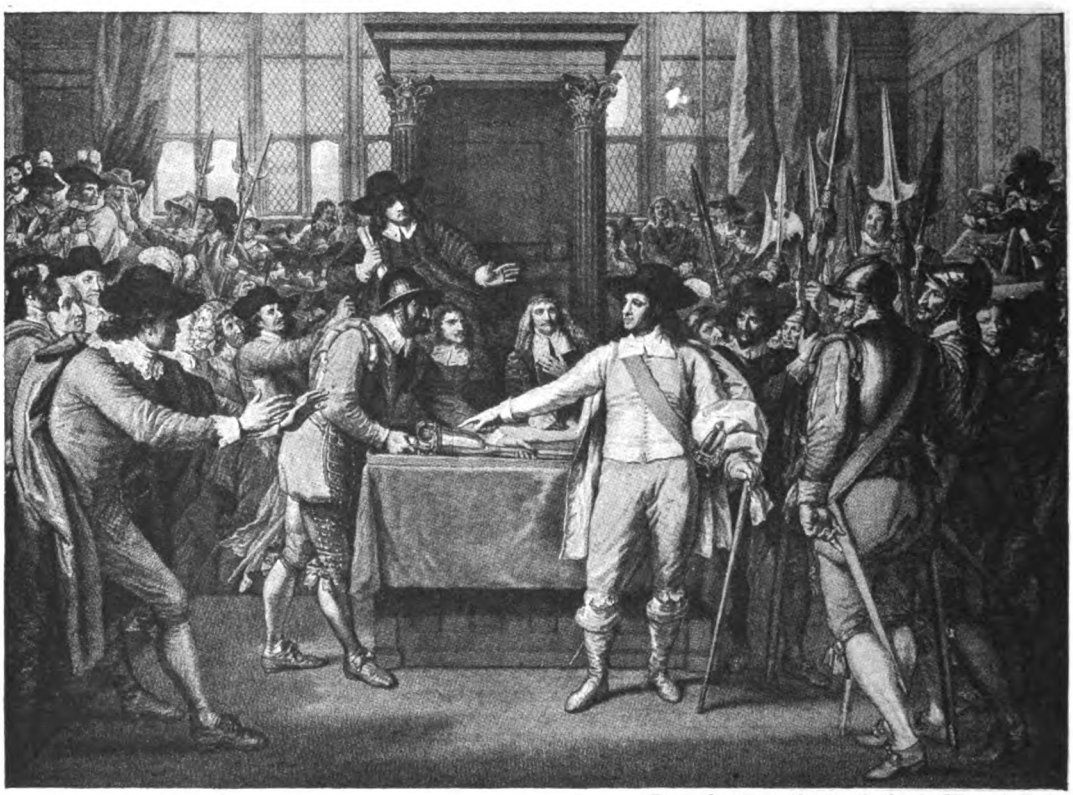
they were ready to employ, without scruple, any means, however violent and lawless. It was not impossible, therefore, to establish by their aid a dictatorship such as no King had ever exercised : but it was probable that their aid would be at once withdrawn from a ruler who, even under strict constitutional restraints, should venture to assume the kingly name and dignity.

The sentiments of Cromwell were widely different. He was not what he had been ; nor would it be just to consider the change which his views had undergone as the effect merely of selfish ambition. It would have been strange indeed if his notions had been still the same as in the days when his mind was principally occupied by his fields and his religion, and when the greatest events which diversified the course of his life were a cattle fair or a prayer meeting at Huntingdon.

He saw that some schemes of innovation for which he had once been zealous, whether good or bad in themselves, were opposed to the general feeling of the country, and that, if he persevered in those schemes, he had nothing before him but constant troubles, which must be suppressed by the constant use of the sword. He therefore wished to restore, in all essentials, that ancient constitution which the majority of the people had always loved, and for which they now pined.

The course afterwards taken by Monk was not open to Cromwell. The memory of one terrible day separated the great regicide for ever from the House of Stuart.

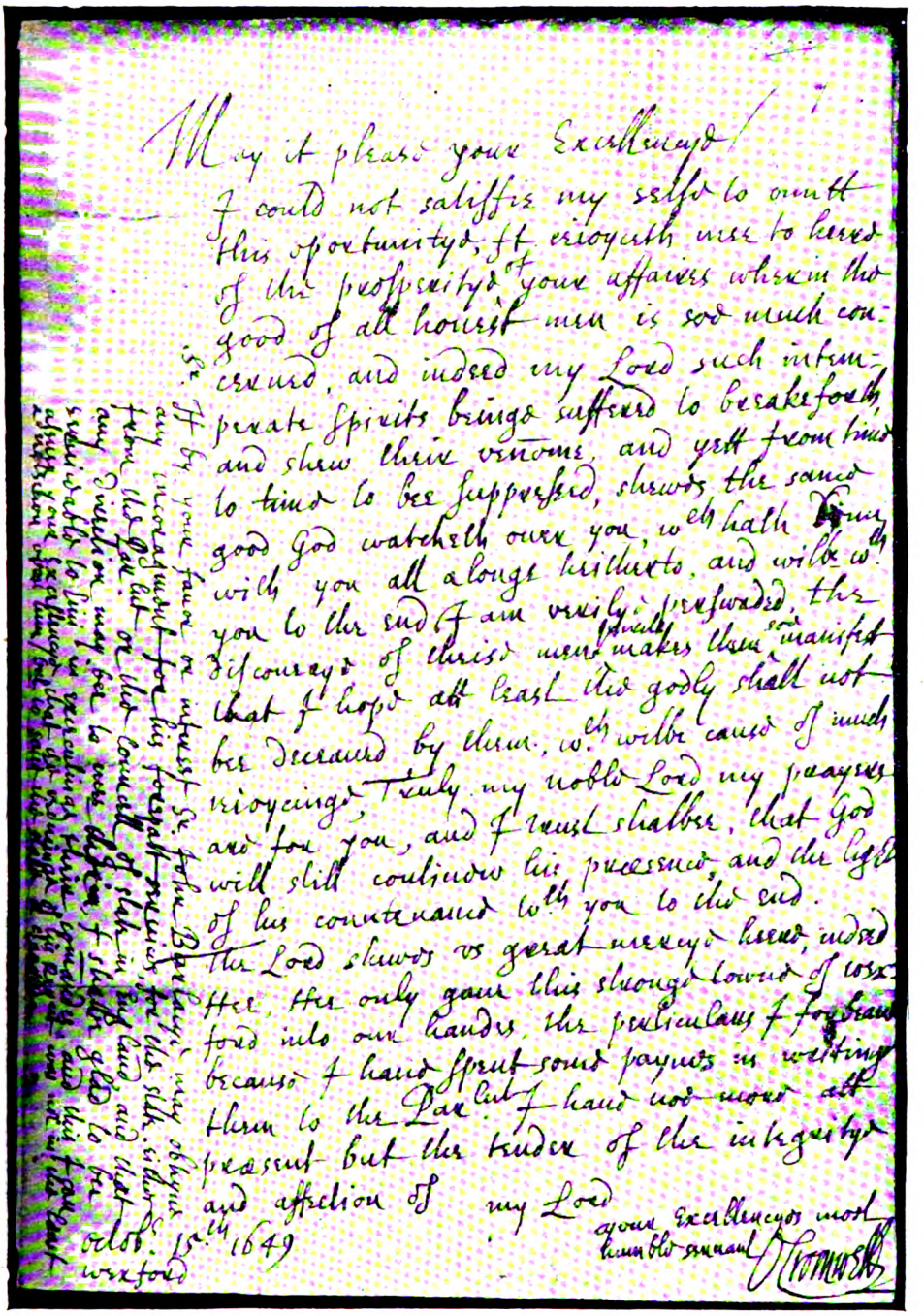
What remained was that he should mount the ancient English throne, and reign according to the ancient English polity. If he could effect this, he might hope that the wounds of the lacerated State would heal fast. Great numbers of honest and quiet men would speedily rally round him. Those Royalists whose attachment was rather to institutions than to persons, to the kingly office than to King Charles I. or King Charles II., would soon kiss the hand of King Oliver. The peers, who now remained



From the picture by Sir Benjamin West, P.R.A.

CROMWELL DISSOLVING THE LONG PARLIAMENT

on April 20th, 1653, as a result of pressure brought to bear on him by the army. Members were driven from the House by force. The Long Parliament had been sitting since Nov. 3rd, 1640 ; it did not reassemble until May, 1659, when the republicans allied themselves with the army to overthrow Richard Cromwell.



May it please your Excellencye!

I could not satisfie my selfe to omitt this oportunitye, it reioyceth mee to heere of the prosperitye of your affaires wherein the good of all honest men is soe much concerned, and indeed my Lord such intemperate spirits beinge suffered to breakeforth, and shew their venome, and yett from time to time to bee suppressed, shewes the same good God watcheth over you, wch hath done with you all alonge heitherto, and wilbe wth you to the end I am verilye perswaded, the discoverye of theise men spirits makes them soe manifest that I hope att least the godly shall not bee deceaved by them, wch wilbe cause of much reioycinge, Truly my noble Lord my prayers are for you, and I trust shalbee, that God will still continue his presence, and the light of his countenance wth you to the end.

The Lord shewes vs great mercye heere, indeed Hee, Hee only gave this stronge towne of Wexford into our handes, the perticulars I forbeare because I have spent some paynes in writing them to the Parlt I have noe more att present but the tender of the integritye and affection of my Lord

your Excellencyes most humble servant

O Cromwell

Octob. 15th 1649
Wexford

Sr. If by your favor or interest Sr. John Barlacye may obtyne any encoragment for his forsyatt services for the state either from the Parlt or the Councell of state in England, and that any direction may bee to mee therein I shalbe glad to bee serviceable to him in executing their commandes, and this I am assure your Excellencye that ye vndeninge of his Regiment was not in the least a detection whose time I bee to satisfie the [illegible]

Facsimile of an autograph letter from Oliver Cromwell to Lord Fairfax announcing the capture of Wexford. Cromwell landed in Ireland in Aug., 1649. Having stormed Drogheda (Sept. 11th) and massacred the garrison, he turned his attention to Wexford (Oct. 9th), which shared the fate of Drogheda, some 4,000 people being slaughtered. The campaign closed with an unsuccessful siege of Waterford.

sullenly at their country houses, and refused to take any part in public affairs, would, when summoned to their House by the writ of a King in possession, gladly resume their ancient functions.

The ablest Royalists were of opinion that these views were correct, and that, if Cromwell had been permitted to follow his own judgment, the exiled line would never have been restored. But his plan was directly opposed to the feelings of the only class which he dared not offend. The name of King was hateful to the soldiers. Some of them were indeed unwilling to see the administration in the hands of any single person. The great majority, however, were disposed to support their general, as elective first magistrate of a commonwealth.

Constitutional Experiments

All that Cromwell could do, therefore, was to give to the new republic a constitution as like the constitution of the old monarchy as the army would bear.

His plan bore, from the first, a considerable resemblance to the old English constitution: but, in a few years, he thought it safe to proceed further, and to restore almost every part of the ancient system under new names and forms. The title of King was not revived: but the kingly prerogatives were entrusted to a Lord High Protector. The sovereign was called not His Majesty, but His Highness. He was not crowned and anointed in Westminster Abbey, but was solemnly enthroned in Westminster Hall. His office was not declared hereditary: but he was permitted to name his successor; and none could doubt that he would name his son.

A House of Commons was a necessary part of the new polity. In constituting this body, the Protector showed a wisdom and a public spirit which were not duly appreciated by his contemporaries. The vices of the old representative system, though by no means so serious as they afterwards became, had already been remarked by far-sighted men.

Cromwell reformed that system on the same principles on which Mr. Pitt, a hundred and thirty years later, attempted to reform it, and on which it was at length reformed. Small boroughs were disfranchised even more unsparingly than in 1832; and the number of county members was greatly increased.

Very few unrepresented towns had yet grown into importance. Of those towns the most considerable were Manchester, Leeds, and Halifax. Representatives were given to all three.

An addition was made to the number of the members for the capital. The elective franchise was placed on such a footing that every man of substance, whether possessed of freehold estates in land or not, had a vote for the county in which he resided. A few Scotsmen and a few of the English Colonists settled in Ireland were summoned to the assembly which was to legislate, at Westminster, for every part of the British Isles.

To create a House of Lords was a less easy task. Democracy does not require the support of prescription. Monarchy has often stood without that support. But a patrician order is the work of time. Oliver found already existing a nobility, opulent, highly considered, and as popular with the commonalty as any nobility has ever been.

Had he, as King of England, commanded the peers to meet him in Parliament according to the old usage of the realm, many of them would undoubtedly have obeyed the call. This he could not do; and it was to no purpose that he offered to the chiefs of illustrious families seats in his new senate. They conceived that they could not accept a nomination to an upstart assembly without renouncing their birthright and betraying their order. The Protector was, therefore, under the necessity of filling his Upper House with new men who, during the late stirring times, had made themselves conspicuous.

Foreign Policy

This was the least happy of his contrivances and displeased all parties. How Oliver's Parliaments were constituted, however, was practically of little moment: for he possessed the means of conducting the administration without their support, and in defiance of their opposition.

Such confusion, moreover, as existed at home was compensated by the success of the Protector's foreign policy. If his great plan for the union of the Protestant powers failed, the alliance with France ripened into an offensive and defensive league against Spain, and the Battle of Dunkirk (June 4, 1658) made his arms renowned throughout Europe.

Cromwell's person and character are thus described by a gentleman of his household:—"His body was well compact and strong; his stature under six foot (I believe about two inches); his head so shaped as you might see it a storehouse and shop both of a vast treasury of natural parts. His temper exceedingly fiery, as I have known, but the flame of it kept down for the most part, or soon allayed with those moral endowments he had. He was naturally compassionate towards objects in distress, even to an effeminate measure."

Continued from page 406.

SCIENCES:

Contributors:—ANTHROPOLOGY AND ETHNOLOGY (Sir H. H. Johnston, G.C.M.G., K.C.B.). ASTRONOMY (Arthur R. Hinks, M.A., F.R.S.). BOTANY (E. W. Edmunds, M.A., B.Sc.[Lond.]). CHEMISTRY (E. H. Tripp, Ph.D.). ELECTRICITY AND MAGNETISM (L. M. Parsons, M.Sc., D.I.C., F.G.S.). GEOLOGY AND MINERALOGY (Arthur Holmes, D.Sc.[Lond.], A.R.C.S., D.I.C., F.G.S.). PHYSIOLOGY (Sir Malcolm Morris, K.C.V.O., and D. W. Carmalt-Jones, M.A., M.D.[Oxon.]). SOUND, LIGHT, AND HEAT (E. W. Edmunds, M.A., B.Sc.[Lond.]). ZOOLOGY (E. A. Bryant and Ashley G. Brown, F.Z.S.).

ELECTRICITY AND MAGNETISM.—XIX

Currents Induced by other Currents.—Variations in the intensity of the magnetic field around any wire carrying an electric current may be employed as a means of inducing currents in a closed circuit quite distinct from that along which the inducing current flows.

Experiment 58.—*To induce a current in a coil of wire by means of variations in the magnetic field of a current flowing in another wire circuit.*

Around a pencil or wooden skewer wind many turns of moderately thick insulated copper wire. A sufficient length of wire should be used so that at least two layers may be wound one on top of the other, and the winding should be always in the same direction. At each end five or six inches of wire must be left uncoiled for purposes of connection. The coil so made is known as the *Primary Coil* and is that along which the inducing or *primary current* will be sent. Take several yards of well insulated wire, preferably thinner than that just used, and wind it around and on top of the primary coil, leaving about ten inches at each end. This coil wound around the primary is known as the *Secondary Coil*, or that along which the induced or *secondary currents* will flow. The ends of the secondary coil must now be connected to those of the wire of your astatic galvanometer so that a complete circuit is formed. Arrange in series as many cells as you can and connect one terminal of the battery to an end of the primary coil. When the galvanometer is steady, firmly press the free end of the primary coil against the other terminal of the battery. Note the movement of the galvanometer indicating the presence of a current induced in the secondary coil. Still keeping the current from the battery flowing in the primary coil, allow the needle to come to rest, and then suddenly stop the primary current by removing the wire from the terminal of the battery. Note the movement of the galvanometer and the direction of such movement.

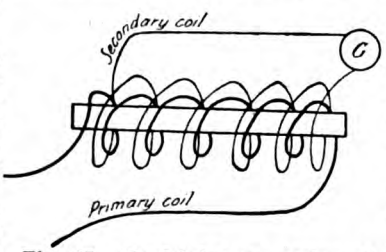


Fig. 65.—Explaining the action of a secondary coil.

In order that noticeable results may be obtained a good current must be sent along the primary coil, and a very sensitive galvanometer must be used.

Our observations teach us that when a current is sent along the primary coil a momentary induced current flows along the secondary coil, and that when the current in the primary is stopped another momentary current flows along the secondary coil but in a direction opposite to that of the first induced current.

We have seen that a necessary condition for the production of induced currents is *variation in the intensity of the magnetic field* in which are situated the wires along which the induced currents flow. This explains why the currents induced in the secondary coil during our experiment were of a *momentary* nature. The magnetic field of the primary current extends through the coils of the secondary as long as the primary current flows, but currents are induced in the secondary coil only when the magnetic field of the primary *varies in intensity*. Such variation occurs only at the moments of commencement and cessation of the primary current.

Experiment 59.—*To observe if there is any connection between the direction of the primary current and that of the induced currents.*

Arrange the battery, coils of wire and galvanometer as in the previous experiment. Complete the circuit of the primary current and notice the direction in which it flows. Observe the direction in which the galvanometer needle moves, and by Ampère's rule (Vol. III., p. 78) determine the direction of the induced current. Allow the needle to become steady, break the primary circuit, and again determine the direction of the induced current.

The results of this experiment show that when the primary current is started the induced current flows along the secondary coil in a direction opposite to that of the primary current, and that when the

primary current stops the induced current flows in the same direction as that in the primary.

The Influence of an Iron Core.—When the coils are wound around a bar of soft iron in place of the pencil or wooden skewer a magnetic field of greater intensity will be produced.

Experiment 60. — *To observe the effect of winding the coils upon an iron core.*

Remove both primary and secondary coils from the pencil and rewind them in the same manner as before on a rod of soft iron. A large iron nail or a bundle of iron wires will do if no other piece is available.

Arrange the battery, coils and galvanometer as in the other experiments. When the primary current is made and stopped, notice the larger deflection of the galvanometer. When an iron core is used the induced currents are stronger owing to the greater magnetic field produced or destroyed when the primary current starts or stops.

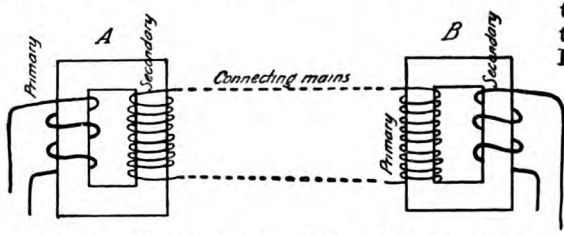


Fig. 66.—Illustrating the use of transformers.

Transformers.—An arrangement of primary and secondary coils insulated from each other and wound around an iron core may supply rapidly succeeding alternating currents, provided that a current sent into the primary is made, broken, and remade in rapid succession. This can be effected by sending the current from an alternator through the primary coil. Unless some definite advantage is to be gained by the use of the induced currents, it would be better to use the primary current itself. But a decided advantage is gained if the coils are so constructed that the secondary is either longer or shorter than the primary, for the ratio of the induced E.M.F. to that in the primary depends upon the ratio of the length of the secondary coil to that of the primary. Thus, if the secondary is ten times the length of the primary, the induced E.M.F. will be ten times as great as that of the primary, but the current strength will be only one tenth of the primary current. For instance, let us suppose that we have a large apparatus in which the secondary coil is ten times the length of the primary, then if an E.M.F. of 1,000 volts is forcing a current of ten amperes along the primary coil, there will be an E.M.F. of 10,000 volts induced in the secondary, but the current strength will be only one ampere.

Such an apparatus is called a transformer, and in the case just quoted, where the induced voltage is higher than that of the primary, the arrangement is known as a *Step-up transformer*. The practical importance of such an apparatus is obvious. In cases where electricity has to be sent from a power station to a distant place for local use it is necessary to have a high voltage in order to overcome the resistance of miles of wire, and an economy is effected by the use of thinner wires.

The high voltage and small number of amperes of the induced current will not be convenient to use as it is, but at the place where it is to be employed it can be transformed into a larger current at a lower voltage by means of a *Step-down transformer*, in which the primary coil is longer than the secondary. If the step-down transformer at the local station has a primary coil 50 times the length of the secondary, then if the transmitted high voltage electricity at 10,000 volts and one ampere is sent along the primary, there will be induced in the secondary a current of 50 amperes at an E.M.F. of 200 volts.

In the measurement of what is termed "electric power" practical units called *watts* are employed, the number of watts being equal to the product of the voltage, multiplied by the current strength. In other words, *watts* = *volts* × *amperes*.

Thus, in the case considered above, it will be noticed that the electric power or number of watts in the primary coil of a transformer is equal to that in the secondary coil, but in actual practice there is always a small loss of power in the transformers themselves and in transmission.

Since no part of a transformer is moved, the necessary variation in the magnetic field is produced by the alternating current supplied to the primary coil. Is there no kind of transformer that can be worked by a direct current?

The Induction Coil.—An instrument very similar to a transformer in general construction, but possessing an appliance which alternately makes and breaks the primary circuit so that a direct (i.e. one way) current may be used in the primary, is called an induction coil. Such a coil is a variety of step-up transformer, since its function is to transform a good current at low voltage into a small current at a very high voltage.

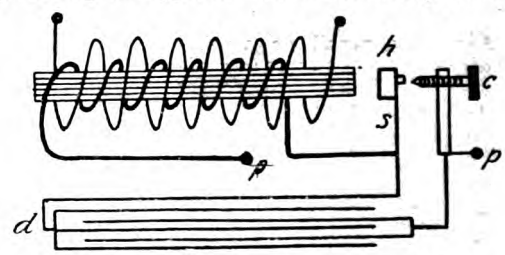


Fig. 67.—Illustrating the action of an induction coil.

The primary coil is composed of a few layers of thick well insulated wire wound upon a core consisting of a bundle of soft iron wires. The secondary coil consists of very fine gauge wire wound layer upon layer around the primary coil, and is always very many times the length of the primary. In larger coils several miles of wire are used in the construction of the secondary. Between the two coils is placed a layer of insulating material which sometimes takes the form of a cylinder of vulcanite. Thorough insulation is an absolute necessity. The ends of the primary and secondary coils are connected with screws which are known respectively

as the primary and secondary terminals. Facing one end of the iron core and a little way from it is a circular piece of soft iron (*h*) attached to a horizontal spring (*s*) supported by a metallic upright. Against the farther side of the spring a screw (*c*) having a platinum point is stationed in such a way that when no current is flowing along the primary coil the spring (*s*) and the platinum point of the screw (*c*) are in contact. In these circumstances the primary circuit is complete and a current will flow along it when the primary terminals (*p p*) are connected to a source of current such as an accumulator.

But the moment, however, the current flows along the primary, the iron core is magnetised and attracts the piece of iron (*h*) on the spring, with the result that the primary circuit is broken immediately the iron moves towards the core. The circuit being broken, the current ceases to

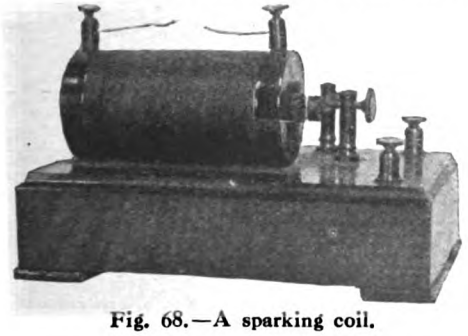


Fig. 68.—A sparking coil.

flow, and the spring (*s*) moves back to remake contact with the point of the screw. The circuit is then complete again, and the movements are repeated.

Consequently the primary current is made and broken several times a second, thereby causing a rapid succession of induced currents to be produced in the secondary coil. The device consisting of the vibrating spring and the screw is known as an interrupter or "make and break." Sometimes an induction coil is made without a make and break, but in that case a separate interrupter, of which there are two or three kinds, must be included in the primary circuit. There are distinct types of induction coils according to the purposes for which they are required. The small medical coils consist of the two coils and the interrupter, the handles being attached to the secondary terminals and the degree of shock being regulated by the withdrawal of a tubular screen that covers the iron core. The larger sparking coils have no screen over the core, since its full influence is to be exercised over the secondary coil, and they possess an additional part called a condenser (*d*), situated at the base of the instrument.

This condenser consists of several sheets of tin foil alternating with layers of paraffined paper, the tin foil being connected with the primary circuit.

A full explanation of the part played by the condenser is not possible here, but it may be stated that it prevents excessive sparking at the interrupter and increases the inductive effect in the secondary coil. L. M. P.

BOTANY.—XIII

36.—The Plant and its Water Supply.

Water is indispensable to the plant for several reasons:

(1) It is necessary in photosynthesis, i.e. as a constituent of the plant's food.

(2) It is necessary in order that dissolved substances can be carried about the plant.

(3) It is necessary to keep the plant firm and erect.

The latter use, though not so obvious, is quite familiar. Indeed, everyone knows how a plant wilts and becomes limp when it cannot obtain water; the water, in fact, has the same kind of effect as the air in a football.

When the cells of the plant are filled and stretched with water, they are said to be turgid or *turgescent*. In this condition the plant is "solid" in the same sense as a blown-up football. When the supply of water becomes insufficient, the turgescence is lost, and the whole plant is flabby and limp.

We have already dealt with the process of osmosis, by which the water is absorbed into the root. Anything that stops that causes the plant to wilt; e.g. if the roots of a plant are put into strong salt solution, the osmosis is injured and a limp plant results. The liquid absorbed by the root ascends the stem, as we know, by the vessels of the xylem or wood, and finds its way finally into the leaves. There much of the water is given off as vapour, by a process known as *transpiration*, so that a current of water is maintained through the plant, from the soil to the air.

This is known as the *transpiration-current*.

That the xylem really carries this current can be studied very well with seedlings whose roots are kept in red-ink. The red streaks can quite easily be followed in mustard-seeds, in young sunflowers and in the seedlings of vegetable marrow.

If the branch of a tree be "ringed," i.e. if a ring of bark be cut off completely round the stem as far down as the wood, leaving only the wood and pith (if any) intact, it will be found that the branch thrives perfectly well. In fact, it thrives better than the unringed branches, because the phloëm has been cut off, and it is through the phloëm that the elaborated food-stuff, especially sugar, passes from the leaves into the rest of the plant. The sugar that would be lost to the branch is kept in it—for the ultimate benefit of its fruit and seeds.

Water will ascend directly into the xylem vessels, as we know from the fact that cut flowers or leafy shoots will keep alive a long time if put in water, but soon wither without it. A cut shoot whose cut end has been

placed in melted paraffin wax does not last long, even if it be placed in water, because the vessels have been choked up by the wax.

It is a difficult problem to explain how the water is forced up the vessels—for example, in a tree sixty feet high. We know that certain forces aiding the process exist — root-pressure, capillarity and the suction which is caused by the transpiration in the leaves; but these are by no means sufficient, and the *chief* cause of the ascent of sap in plants still eludes us.

37. Transpiration. — That there is a constant loss of water from the leaves of plants may be easily shown, and the student should perform the following experiments for himself.

DEMONSTRATION XXVI

1. Cover the soil in a flower-pot with cardboard and place the pot with its plant under a bell-jar or glass shade. A mist soon forms on the inside of the shade, which must have been supplied from the plant, since the escape of moisture from the soil in the pot has been prevented.

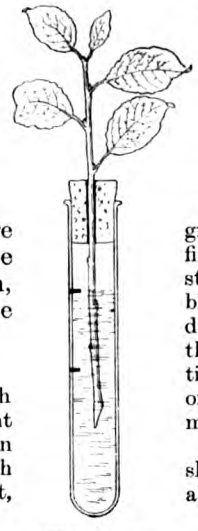


Fig. 84A.— To demonstrate the constant loss of water from the leaves of a plant.

2. Fit up a test-tube with a cork, through which a leafy shoot has been inserted. Take care that the hole in the cork is completely stopped with plasticine. Insert the cork after filling the test-tube with water up to a mark which is indicated with gummed paper (Fig. 84A). Weigh the whole, leave for 24 hours, and weigh once more. Again indicate the level of the water, and measure with a burette how much water has disappeared.

With the very simple apparatus used for the above experiment, a considerable amount of useful work can be done.

If, for example, it be supported underneath a bell-jar whose edges have been vaselined to prevent the entrance of fresh air, it will be noticed that the loss of water is almost equal to what it was in the open air at first, but that after a time it becomes much slower, and finally ceases.

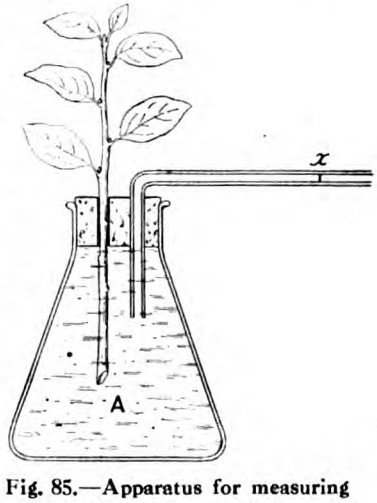


Fig. 85.—Apparatus for measuring rate of transpiration.

This is because the air is saturated with water vapour, and further evaporation cannot go on. There is less transpiration in damp air.

Again, the loss of water which we measure indicates the amount of water absorbed; but we shall find always that the loss of weight is not great enough to correspond to this. On reflection we see that this is probable, because the plant will gain weight by photosynthesis during the day; and possibly also some of the water will be retained by the plant. Even in the dark transpiration is not always equal to absorption; it may even be greater if the air be very dry and warm.

3. Transpiration can be indicated on any growing plant by means of cobalt paper, i.e. filter-paper which has been dipped in a strong solution of cobalt chloride. This is blue when dry, but very pale pink when damp. To use it, place a piece of it between the leaf and a small piece of glass which is tied on to the leaf with thread. The change of tint, and its rapidity, show the presence of moisture, and roughly its degree.

With this simple means, it is easy to show that in most leaves transpiration is almost confined to the underside. This is a valuable arrangement, because the loss is thereby steadied; the underside of the leaf is the shady side, and does not receive the full effect of the noon-day sun and the consequent acceleration of evaporation. The experiment should be tried on different plants; it will then be observed that the leaves of evergreens transpire less than deciduous leaves—that dry and skinny leaves also transpire little.

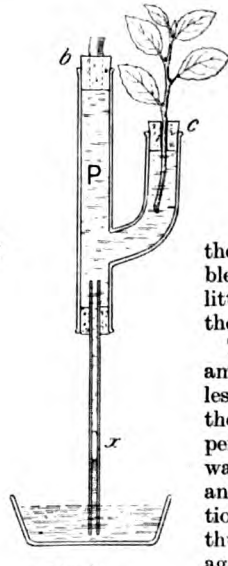


Fig. 86.— A more elaborate apparatus for measuring rate of transpiration.

The loss of water vapour naturally suggests that the outer surface of the leaf is somehow porous. If a leaf be suddenly plunged into warm water, a large number of little bubbles may be observed on the under side, and a few on the upper side. These are bubbles of air escaping through little holes in the epidermis of the leaf, called *stomates*.

These stomates we shall examine microscopically in a later lesson. Here we may say that they have the interesting property of closing when the water-supply of the plant fails, and thus preventing transpiration from going on. They are thus an automatic protection against excessive loss of water. For there is apparently little loss through the general surface of the leaf, which is covered by a very thin membrane called the *cuticle*.

This cuticle is a kind of skin, only very slightly permeable by air; it is thicker in such plants as the laurel, box, etc., where diminished transpiration is desirable, and gives to such leaves their glossy look or skinny character. Sometimes it sheds a kind of waxy "bloom," like that of the peach.

4. Take four leaves, e.g. of lime, of as nearly as possible equal size. Smear the under surface of one of them with vaseline; the upper surface of another; both surfaces of the third; and leave the fourth normal. Place the leaves in equal test-tubes of water, and leave them under similar conditions. You will thus be able to observe the effect of closing the stomates upon the rate of transpiration.

[N.B.—Use freshly-gathered leaves, and cut them from the twig under water, in order to prevent air from getting into the vessels.]

5. Smear the under surface of a leaf with vaseline and leave it lying on the table by the side of a similar leaf, unsmeared. Notice that the smeared leaf remains fresh much longer than the other. [Why ?]

The rate of transpiration varies under different conditions.

This can be measured with the following apparatus:—

Take a flask, A (Fig. 85), provided with a two-holed cork, through which are passed, airtight, the shoot to be experimented on, and a long piece of glass tubing of narrow bore bent once at right angles. The flask is filled with water and the cork inserted, when the excess of water is forced out through the tube. As the shoot absorbs water, of course air is drawn along the tube; and the time taken for the boundary line, x, to move along a definite length of the tube can be noted. With this apparatus the rate of transpiration can be watched under varying conditions.

Photo: C. C. Pierce and Co.

ORGAN CACTI OF THE MEXICAN DESERT.

In the plants (Xerophytic) which thrive in desert places, transpiration is checked by a reduction of the leaf surface, as in gorse, or by the retention of water either in the leaves, as in house-leeks, or in the stem, as in cacti.

It can be shown that the same shoot will transpire more quickly in light than in darkness; when it is warm than when it is cool; in dry air than in damp air; in a draught than in still air. Further comparisons can be made between different plants, and between different specimens of the same plant, so as to show the effect of leaf-area, of stopping the stomates by a coat of vaseline, of stopping the vessels of the cut end with plasticine, and so on.

The advantage of the apparatus used in the last experiment is that the observation can be made in a few minutes under constant conditions.

A more elaborate form of the arrangement is shown in Fig. 86.

6. The essential part of the apparatus is the tube, P, known as a *potometer*, which can be bought ready made from dealers in scientific apparatus. A long tube of very narrow, not capillary, bore passes into the lower opening of the potometer tube through a one-holed rubber cork. The plant to be experimented upon is securely fixed through a similar cork, airtight, in the side arm of the potometer. The other arm, extending higher than its neighbour, also has a cork, with a tube that can be closed with a clip.

To set up the apparatus, cover the open end of

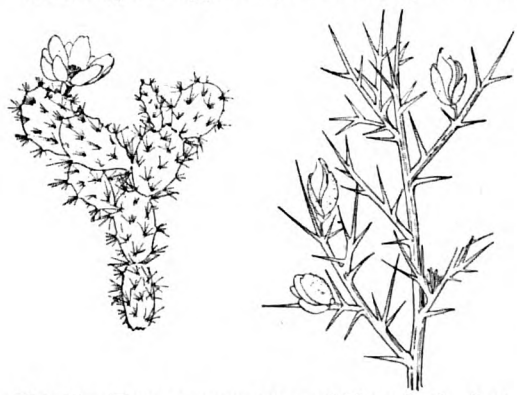


Fig. 87.—Two common types of Xerophytic plant —cactus (left), gorse (right).

the long tube with the finger, and fill the whole with water, taking care that no bubbles of air remain in the tube. Then force the cork, *c*, carrying the shoot, into its place; insert the cork, *b*, and close the clip. Remove the finger; and if the apparatus is airtight, no water will run out of the tube. As the shoot transpires, however, the water rises in the long tube, and a bubble of air follows it. On observing this bubble, place the end of the tube into water coloured with cochineal or other dye. The rate of ascent of the bubble can now be easily observed.

Results of a very satisfactory kind can be obtained with the shoots of various trees, such as lime, beech and horse-chestnut. They should be kept in water for 24 hours, and freshly cut under water, before use.

A. Twig containing 3 leaves of horse-chestnut, each with five leaflets.

Amount of transpiration in 4 hours = 11 cm. of water = 2·5 c.c. approx.

The day was fine and cool, with little sunshine.

If this rate were kept up for 24 hours, the three leaves would transpire 6 × 2·5 = 15 grs. water, and a tree with, say, 10,000 leaves would transpire $\frac{15 \times 10{,}000}{453 \times 3}$ lb. water = about 110 lb. per day.

38. Xerophytic Plants. —Most British plants have their leaves adapted to the promotion of steady transpiration. But there is a large class of plants, spoken of collectively as *xerophytes*, which thrive in dry situations, such as sand-dunes by the sea and similar habitats. While transpiration goes on in these plants, it is obvious that its rate must be regulated and checked.

This is done in two main ways. The opportunities for transpiration may be diminished by a reduction of the leaf-surface (pines, gorse, horsetails, etc.), or by a folding of the leaf, which has the same effect (sheep's fescue and other grasses), or by a covering of hairs which entangle the damp air and impede diffusion (silverweed, mullein, etc.), or by a thickening of the cuticle, or by the insertion of the stomates at a little depth below the surface: all these devices check the loss of water. On the other hand, certain plants are *succulent* owing to the retention of water in the leaves (house-leeks) or stems (cacti), provided with special water-retaining tissue. E. W. E.

MINERALOGY.—V

THE next group of minerals which we have to consider is:—

VI.—SULPHATES

In the following table a few analogous minerals, chromates, molybdates, and tungstates, are included:—

Name	*Composition*	*System*	*H*	*Sp. gr.*	*Streak*
Barytes	$BaSO_4$	Orthorhombic	3	4·5	White.
Celestite	$SrSO_4$	Orthorhombic	3	3·9	White.
Anglesite	$PbSO_4$	Othorhombic	3	6·3	White.
Anhydrite	$CaSO_4$	Orthorhombic	3·5	2·9	White.
Gypsum	$CaSO_4.2H_2O$	Monoclinic	2	2·3	White.
Chalcanthite	$CuSO_4.5H_2O$	Triclinic	2·5	2·2	White.
Epsomite	$MgSO_4.7H_2O$	Orthorhombic	2·5	1·7	White.
Melanterite	$FeSO_4.7H_2O$	Monoclinic	2	1·9	White.
Crocoite	$PbCrO_4$	Monoclinic	3	6·0	Orange red.
Wulfenite	$PbMoO_4$	Tetragonal	3	6·8	Pale yellow.
Wolframite	$(Fe,Mn)WO_4$	Monoclinic	5·5	7·3	Dark brown.
Scheelite	$CaWO_4$	Tetragonal	5	6	White.

1. The Orthorhombic Sulphates.

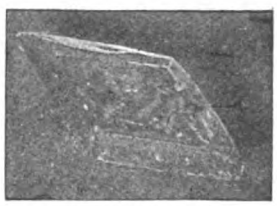
Barytes, or heavy spar, occurs in tabular crystals with a perfect basal and prismatic cleavage and a vitreous lustre. It is a common constituent of metalliferous veins, especially those rich in lead and zinc. It is used as a pigment, for weighting paper, and as a source of barium salts.

Celestite is very similar in habit and appearance to barytes, but it occurs most frequently with sulphur in volcanic districts, and with gypsum and rock-salt in sedimentary formations.

Anglesite, an oxidation product of galena, differs in two respects from the other members of this isomorphous group of minerals. It is easily fusible, and has the adamantine or resinous lustre which is a characteristic of many lead minerals.

2. Gypsum.

$CaSO_4.2H_2O$. *Monoclinic, with the form and cleavages indicated in the figure. H = 2. Sp. gr. = 2·3. Colourless. Lustre, vitreous. Streak, white.*



GYPSUM (Selenite).

Gypsum is a familiar mineral, and is of some importance as the source of Plaster of Paris, which is obtained from it by the process of burning.

When heated and partially dehydrated it forms a cement which, when moistened, re-absorbs water and solidifies strongly by crystallising in a network of fibres.

In compact varieties Gypsum is known as *Alabaster*, and crystalline masses of this mineral with a perfect pinacoidal cleavage are known as *Selenite*.

Gypsum is deposited from solution in association with salt deposits (*see* Section I, p. 397). It is a common mineral in clays and is also formed in volcanic districts in association with sulphur. Under heat and pressure Gypsum loses all its water, and becomes *Anhydrite*, which is quite useless as a cement.

VII.—PHOSPHATES AND ARSENATES.

These may be classified as follows:—

1. Apatite.

$Ca_4(CaF)(PO_4)_3$. *Hexagonal, in hexagonal prisms terminating in a pyramid. H = 5. Sp. gr. = 3·2. Colour, variable, frequently green and brown. Lustre, vitreous.*

Apatite in microscopic crystals occurs in all igneous rocks, but in large crystals and masses it is associated with gabbros. It really consists of three compounds which are isomorphous, for the fluorine of the above formula may be replaced by chlorine or hydroxyl (OH). Apatite is used for manure, but the organic phosphate deposits (phosphorite, coprolites, guano, etc.) are of more value in this respect.

These materials, however, though essentially made up of calcium phosphate, are concretionary and earthy, totally unlike the well crystallised mineral Apatite.

Pyromorphite, $Pb_4(PbCl)(PO_4)_3$, and the other lead minerals of this group are isomorphous with Apatite, and all occur in hexagonal prisms with the characteristic resinous lustre of oxidised lead minerals.

VIII.—BORATES AND NITRATES

1. Borates.

The chief minerals of this type are—

Borax	.. $Na_2B_4O_7.10H_2O$	.. Monoclinic.
Colemanite	.. $Ca_2B_6O_{11}.5H_2O$	.. Monoclinic.
Ulexite	.. $NaCaB_5O_7.8H_2O$	.. Monoclinic.
Boracite	.. $Mg_7Cl_2B_{16}O_{30}$	.. Cubic above 265°.

Borates are found as saline residues in association with rock-salt, gypsum, etc. They owe their origin to crystallisation both from salt lakes and inland seas, and from thermal springs in volcanic regions. Boracite is interesting as being cubic only above 265°. Below that temperature it retains the same external form, but is built up internally of complex aggregates of orthorhombic twins.

Borax occurs in prismatic crystals and in granular and earthy deposits. This mineral and other borates are used for the manufacture of boric acid and borax, which are employed as fluxes, cleansing and preserving agents.

Name	*Composition*	*System*	*H*	*Sp. gr.*	*Colour**
Apatite	$Cu_4(CaF)(PO_4)_3$	Hexagonal	5	3·2	Green, brown, etc.
Pyromorphite ..	$Pb_4(PbCl)(PO_4)_3$	Hegaxonal	3·5	7	Green and yellow.
Mimetite ..	$Pb_4(PbCl)(AsO_4)_3$	Hexagonal	3·5	7	Green and yellow.
Vanadinite ..	$Pb_4(PbCl)(VO_4)_3$	Hexagonal	3	7	Red and yellow.
Monazite ..	$(Ce, La, Di)PO_4$	—	5·5	5·2	Yellow-brown.
Libethenite ..	$(CuOH)CuPO_4$	Orthorhombic	—	—	Dark green.
Olivenite ..	$(CuOH)CuAsO_4$	Orthorhombic	3	4·1	Olive green.
Vivianite	$Fe_3(PO_4)_2.8H_2O$	Monoclinic	2	2·6	Indigo blue.
Erythrite ..	$Co_3(AsO_4)_2\,8H_2O$	Monoclinic	2	2·9	Crimson.
Annabergite ..	$Ni_3(AsO_4)_2\,8H_2O$	Monoclinic	—	—	Apple green.
Torbernite ..	$Cu(UO_2)_2(PO_4)_28H_2O$	Tetragonal	2·5	3·5	Emerald green.
Autunite ..	$Ca(UO_2)_2(PO_4)_28H_2O$	Orthorhombic	—	—	Lemon yellow.
Carnotite ..	$K_2(UO_2)_2(VO_4)_23H_2O$	—	—	—	Canary yellow.
Wavellite ..	$(AlOH)_3(PO_4)_2.5H_2O$	Orthorhombic	3·5	2·3	Variable.
Turquoise ..	$Cu(AlOH)_5(PO_4)_43H_2O$	Triclinic	6	2·7	Sky blue.

* The streak in all cases is white, sometimes with a pale suggestion of the colour.

2. Nitrates.

Nitre, Saltpetre	KNO_3	Orthorhombic.
Nitratine, Soda Nitre, Chile Saltpetre	$NaNO_3$	Hexagonal.

Nitrates are soluble in water, and are therefore restricted in their natural occurrence to arid regions. They are formed in the soil by the oxidation of organic matter, aided by certain bacteria, and also by deposition from solutions of volcanic origin. The common association of borates and nitrates adds support to the latter view. The soda nitre is very abundant in the famous deposits of the desert regions of northern Chile, which are of enormous importance as the chief source of nitrate fertilisers. The natural occurrence of the potassium salt is very limited; it is, however, prepared from soda nitre by interaction with potassium chloride.

IX.—SILICATES

Classification of the Silicates

Silicate minerals are to be regarded as the salts of various silicic acids in which the hydrogen is replaced by various metals, either alone or in combination with oxygen, hydroxyl (HO), fluorine, etc. The simpler acids, real and hypothetical, are as follows:—

1. **Orthosilicic acid,** H_4SiO_4.
   From this the following acids are formed by loss of water:
2. **Metasilicic acid,** H_2SiO_3.
   $H_4SiO_4 - H_2O = H_2SiO_3$
3. **Trisilicic acid,** $H_4Si_2O_7$.
   $3H_4SiO_4 - 4H_2O = H_4Si_3O_7$

Examples of minerals of which the above are the ideal acids are as follows:—

1. **Orthosilicates—**

Olivine	$(Mg,Fe)_2SiO_4$
Nepheline	Na_3AlSiO_4
Sodalite	$Na_4(AlCl)Al_2(SiO_4)_3$
Garnets	e.g. $Ca_3Al_2(SiO_4)_3$
Epidotes	e.g. $Ca_2(AlOH)Al_2(SiO_4)_3$
Zircon	$ZrSiO_4$
Micas	e.g. $H_2KAl_3(SiO_4)_3$
Anorthite	$CaAl_2(SiO_4)_2$
Topaz	$(AlF)_2SiO_4$
Willemite	Zn_2SiO_4
Hemimorphite	$Zn_2SiO_4.H_2O$
Dioptase	H_2CuSiO_4
Garnierite	$H_2(Ni,Mg)SiO_4$

2. **Metasilicates—**

Pyroxenes, e.g.:	
Enstatite	$MgSiO_3$
Diopside	$MgCa(SiO_3)_2$
Aegirine	$NaFe(SiO_3)_2$
Amphiboles, e.g.:	
Anthophyllite	$MgSiO_3$
Tremolite	$Mg_3Ca(SiO_3)_4$
Riebeckite	$NaFe(SiO_3)_2.FeSiO_3$
Leucite	$KAl(SiO_3)_2$
Beryl	$Al_2Be_3(SiO_3)_6$
Zeolites	e.g. $NaAl_2(SiO_3)_4.2H_2O$
Talc	$H_2Mg_3(SiO_3)_4$
Chrysocolla	$CuSiO_3.2H_2O$

3. **Trisilicates—**

Felspars, e.g.:	
Orthoclase	$KAlSi_3O_8$
Albite	$NaAlSi_3O_8$

Notice, however, that the felspar Anorthite is an orthosilicate.

1. Silicates as Rock-forming Minerals.

The importance of the silicate minerals in rocks is strikingly shown by the following table, in which the average composition of igneous rocks is expressed mineralogically:—

Felspars	60
Pyroxenes and Amphiboles	17
Quartz	12
Micas	4
Other minerals	7
	100

From their natural occurrence, silicates fall into a number of well-defined groups, and, in order to emphasise their geological importance, they will be described here, not primarily according to the classification given in Section IX, which is incomplete, but in accordance with their natural associates.

2. The Felspars.

The felspars are the most important of all the rock-forming minerals, and form a compact isomorphous group, of which the following molecules are the chief constituents:—

Or =	Orthoclase	$KAlSi_3O_8$	Monoclinic
Ab =	Albite	$NaAlSi_3O_8$	Triclinic
An =	Anorthite	$CaAl_2(SiO_4)_2$	Triclinic

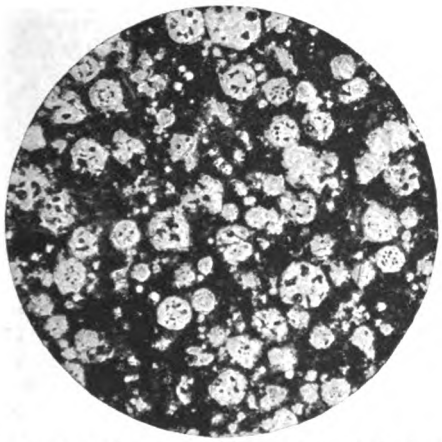
The minerals represented by these formulæ, and their isomorphous mixtures, form a series with a strong family likeness. In the following list the chief varieties, and the nomenclature applied to them, are summarised; figures showing the variation of specific gravity with chemical composition are also given. The hardness in all cases is 6.

Sp. gr.		Ab	An	
	Alkali Felspars—			
2·54	**Orthoclase** $Or = KAlSi_3O_8$			Monoclinic
2·56	Soda-orthoclase $(K,Na)AlSi_3O_8$			Monoclinic
2·54	Microcline $KAlSi_3O_8$			Triclinic
2·58	Anorthoclase $(Na,K)AlSi_3O_8$			Triclinic
2·60	**Albite** $Ab = NaAlSi_3O_8$			Triclinic
	Calc-alkali, Soda-lime or Plagioclase Felspars—			
2·62	**Albite**	100	0	Triclinic
2·64	Oligoclase	90	10	Triclinic
		80	20	Triclinic
		70	30	Triclinic
2·67	Andesine	60	40	Triclinic
		50	50	Triclinic
2·70	Labradorite	40	60	Triclinic
		30	70	Triclinic
2·73	Bytownite	20	80	Triclinic
		10	90	Triclinic
2·75	Anorthite	0	100	Triclinic
2·76	**Anorthite.** $An = CaAl_2(SiO_4)_2$			Triclinic

Besides these, there is a barium felspar, celsian $BaAl_2(SiO_4)_2$, and isomorphous mixtures of orthoclase with this and with anorthite also occur, but only sparingly.

3. Orthoclase.

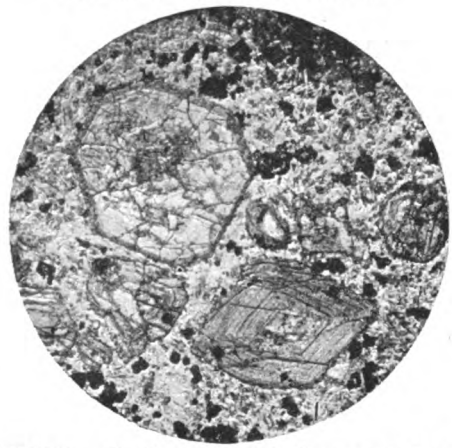
The figures on page 462 illustrate the chief habits assumed by crystals of orthoclase. When crystals are well shaped and completely bounded by crystal faces, they are said to be *idiomorphic* or *euhedral*; when only partly bounded by planes



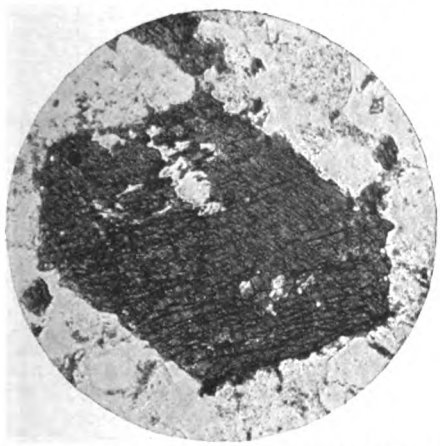
LEUCITE: Showing characteristic inclusions; in Leucitite, from near Rome.

NEPHELINE: Rectangular section (light), and NOSEAN: Six-sided cross section (dark); in Phonolite, from Brix, Bohemia.

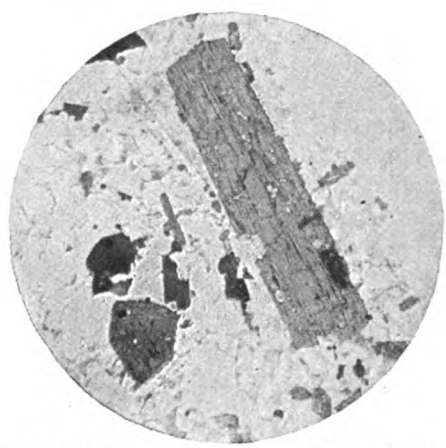
AUGITE: Eight-sided cross section indented by black crystals of magnetite; in Augite-andesite, from Tetschen, Bohemia.



AUGITE: Section showing form and zonal structure; in Dolerite, from Grenada.



HORNBLENDE: Cross section showing cleavage; in Quartz Diorite, from Hodrics, Hungary.



HORNBLENDE: Showing form of a vertical section; in Quartz Diorite, from Hodrics, Hungary.

PHOTOMICROGRAPHS OF SILICATE MINERALS.

Seen in thin sections under the Microscope

they are called *hypidiomorphic* or *subhedral*; when in shapeless masses without faces, the terms *allotriomorphic* or *anhedral* are applied to them. Orthoclase occurs in idiomorphic crystals as *phenocrysts*, or large crystals embedded in the finer-grained constituents of igneous rocks, and also in drusy cavities. *Adularia* is the name given to a transparent or translucent variety occurring in massive rocks. As moonstone it is largely used as a gem.

Clear glassy orthoclase is most frequently found in

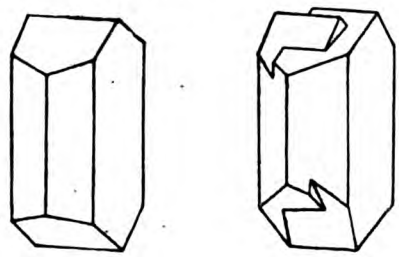


Fig. 59.—Simple and twinned crystals of Orthoclase.

lavas, and is then known as *Sanidine*. Usually, however, orthoclase is opaque, and grey or red in colour. The latter tint is very characteristic, being due to the presence of ferric oxide. The cleavage of orthoclase is roughly parallel to the pinacoids, which are at right angles to each other. Cleavage surfaces, with a vitreous to pearly lustre, can nearly always be seen, even when the grains are small, and are of great importance in recognising the mineral. The twins of orthoclase are of three kinds:—

1. *Carlsbad.*
2. *Baveno.*
3. *Maneback.*

Microcline is a triclinic form of orthoclase, frequently of a green colour (Amazon stone). It is remarkable for its fine lamellar twinning, which produces two sets of striations, parallel to the clino-pinacoidal cleavage and nearly parallel to the basal cleavage respectively.

On certain faces, both sets may be seen as a cross-hatching which is very characteristic. This structure is beautifully exhibited when a thin section of the mineral is seen under the microscope between crossed nicols (*see* p. 341).

4. The Plagioclase Felspars.

The crystal form is similar to that of orthoclase, tabular varieties being common.

Cleavages are well developed, and as plagioclases (oblique breaking) are triclinic the angle between them is not 90°. It is so nearly 90° that the difference may be said to be of little value for determinative purposes.

The albite twinning already illustrated is repeated again and again, sometimes on so fine a scale that the lamellæ can only be seen with the microscope (p. 341).

Often, twinning can be seen as a series of striations on the basal cleavage, a characteristic which distinguishes the plagioclases from orthoclase. White and grey tints are common, and labradorite can frequently be recognised by its bluish-grey colour and play of colours. It is often, however, very difficult to determine the different varieties unless the microscope and thin sections are called in to assist (see p. 341).

In igneous rocks the plagioclase felspars are of such importance that the determination of a rock frequently depends upon that of its felspars. The distribution is roughly as follows:—

Albite (subsidiary to orthoclase) in granites, syenites, and corresponding dyke- and volcanic-rocks.
Oligoclase in syenites and corresponding rocks.
Andesine in diorites and andesites.
Labradorite in gabbros, dolerites and basalts.

5. Kaolin and other Alteration Products.

When the alkali felspars are subject to the action of water charged with carbon dioxide they may become transformed into secondary mica or into kaolin. These changes may accompany ordinary weathering owing to the downward percolation of atmospheric waters, or they may be due to thermal waters rising from below. In the latter case hydrofluoric acid may be the active decomposing agent.

The mixture of epidote (zoisite) and felspar (albite) or of epidote and secondary mica is known as *Saussurite*, and was originally thought to be a single mineral. Under tropical conditions, felspars, and especially plagioclases, may lose all their silica, lime and alkalis, and be reduced to a mixture of aluminium hydrates, known when pure as *bauxite*, and used as a source of aluminium.

Of all the alteration products of felspar, *Kaolin*, $H_4Al_2Si_2O_9$, is by far the most important. It usually occurs in compact or friable masses, and when rubbed between the fingers it has a smooth, unctuous feel. It crystallises in the monoclinic system, and forms thin micaceous flakes, but good crystals, even when very minute, are not frequently seen. Kaolin and secondary mica are the chief constituents of clays. Pure kaolin is known as china clay, and is worked on a large scale in Cornwall, where it occurs in decomposed granites, for the manufacture of china and porcelain.

6. The Felspathoids.

The felspathoids constitute a group of minerals which are analogous to the felspars, but in which the proportion of silica is lower. They therefore occur in rocks which are deficient in silica and rich in alkalis. Quartz cannot occur as a primary mineral with the felspathoids, because felspars would then be formed instead by their union. The chief members are:—

			Sp. gr.
Leucite ..	$KAl(SiO_3)_2$	Cubic	2·5
Nepheline ..	Na^*AlSiO_4	Hexagonal	2·6
Cancrinite ..	$3NaAlSiO_4.NaHCO_3$	Hexagonal	2·45
Sodalite ..	$3NaAlSiO_4.NaCl$	Cubic	2·3
Nosean ..	$3NaAlSiO_4.Na_2SO_4$	Cubic	2·3
Haüyne ..	$3(Na_2Ca)Al_2(SiO_4)_2.2Na_2SO_4$	Cubic	2·45
Lapis-lazuli	$3NaAlSiO_4.Na_2S_3$	Cubic	2·4

The hardness in each case is about 5·5.

* Na may be partially replaced by K in this and the other minerals of the group.

7. Nepheline.

Nepheline crystallises in stout hexagonal prisms, but it is generally found in shapeless grains which look like quartz. When pure it is white, but grey, smoky and reddish tints are more common. It has a greasy lustre and no good cleavage. Felspar will generally scratch nepheline but not quartz, but apart from this it is difficult to distinguish from quartz except by chemical means, unless, of course, good crystals are developed. The massive form is called *Elæolite*. The felspathoids, like the felspars, readily alter to kaolin and secondary mica, but the change to zeolites is more usual—e.g.:

$$NaAlSiO_4 + SiO_2 + H_2O = \underset{\text{Analcite}}{NaAl(SiO_3)_2.H_2O}.$$

Leucite crystallises in trapezohedra, which are truly cubic above 433° C., but which on cooling preserve their outer form but take on an orthorhombic structure internally. Leucite is rare except in the lavas of Vesuvius and Central Italy.

Sodalite occurs in rhomb-dodecahedra, but shapeless grains are more usual. The colour is generally blue, owing to the presence of lapis-lazuli, from which ultramarine was at one time made.

Cancrinite is very similar to nepheline, but has a yellow or orange colour, and contains CO_2.

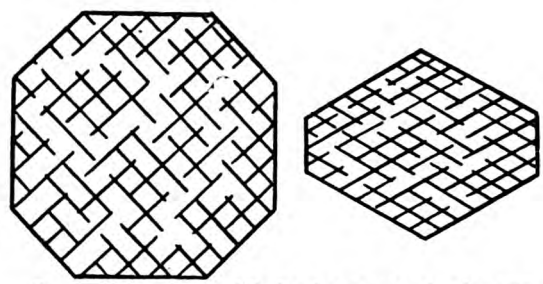
Melilite is a yellow mineral found in felspathoid rocks, where it appears to take the place of anorthite.

8. Pyroxenes and Amphiboles.

These groups include a large number of minerals which, for the most part, may be regarded as salts of metasilicic acid, H_2SiO_3. In augite and hornblende, however, molecules of the type $MgAl_2SiO_6$ appear to be important, though it is possible that this hypothetical molecule is really a combination of the ordinary metasilicate $MgSiO_3$, with alumina, Al_2O_3.

Chemically, however, these two groups may be considered together, as the minerals of the pyroxenes can be paralleled with those of the amphiboles. The chief types are tabulated below.

The hardness is in each case between 5 and 6, generally 5½. The specific gravities are listed below, and in general the amphiboles are less dense than the pyroxenes. All the members of the two groups have good prismatic cleavages, which in the case of the pyroxenes are nearly at right angles, while the angle in the case of the amphiboles is nearly 60°. This constitutes a visible distinction between the two groups, corresponding to the more fundamental differences due to atomic structure.



Pyroxenes and Amphiboles have a good prismatic cleavage, which in the case of Augite (left) is 93° and 87°, i.e. nearly 90°; and in the case of Hornblende (right) is 125° and 55°, i.e. nearly 60°.

Pyroxenes	*Sp. gr.*
Orthorhombic—	
Enslatite, $MgSiO_3$	3·2
Bronzite	3·3
Hypersthene, $(Mg,Fe)SiO_3$	3·45
Monoclinic—	
Diopside, $CaMg(SiO_3)_2$	3·3
Omphacite	
Diopside, $Ca(Mg,Fe)(SiO_3)_2$	3·2
Hedenbergite, $CaFe(SiO_3)_2$	3·5
Augite	3·3
In variable proportions: $Ca(Mg,Fe)(SiO_3)_2$, $(Mg,Fe)(Al,Fe)_2SiO_6$, $Na(Al,Fe)(SiO_3)_2$	
Ægirine / Acmite: $NaFe(SiO_3)_2$	3·5
Jadeite, $NaAl(SiO_3)_2$	3·34
Spodumene, $LiAl(SiO_3)_2$	3·16
Wollastonite, $CaSiO_3$	2·85
Triclinic—	
Rhodonite, $MnSiO_3$	

Amphiboles	*Sp. gr.*
$MgSiO_3$, Anthophyllite	3·15
$CaMg_3(SiO_3)_4$, Tremolite	3·0
Nephrite, Asbestos	
$Ca(Mg,Fe)_3(SiO_3)_4$, Actinolite	3·1
Hornblende: $Ca(Mg,Fe)_3(SiO_3)_4$, $(Mg,Fe)(Al,Fe)_2SiO_6$, $NaAl(SiO_3)_2$ — In variable proportions	3·2
Barkevikite: $4Na_2SiO_3$, $13FeSiO_3$, $3CaSiO_3$, $FeAl_2SiO_6$ — Arfvedsonite	3·45
$NaFe(SiO_3)_2$, $FeSiO_3$ — Crocidolite	3·25
$2NaFe(SiO_3)_2$, $FeSiO_3$ — Riebeckite	3·35
$NaAl(SiO_3)_2$, $(Fe,Mg)SiO_3$ — Glaucophane	3·1
$Na_2(Si,Ti)O_3$, $Fe(Si,Ti)O_3$, $Fe(AlFe)_2SiO_6$ — Cossyrite or Ænigmatite	

A. H.

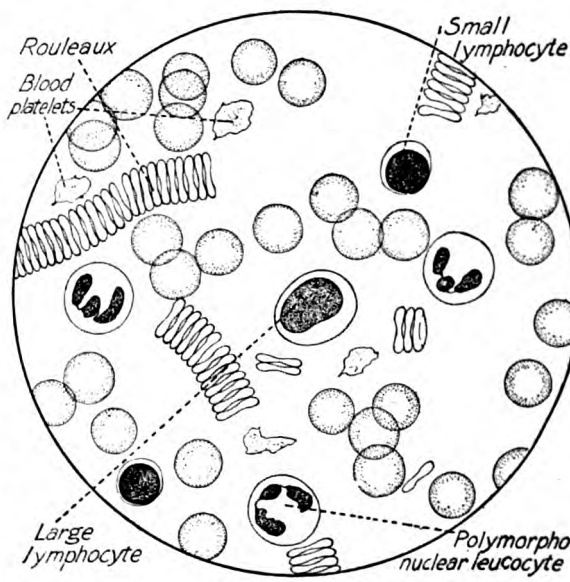
ANATOMY AND PHYSIOLOGY.—VII

THE human machine, which burns up part of itself to do muscular work, requires fresh food for fuel, oxygen to combine with it, and some place where it can pass on the waste products.

Blood—

The *blood* supplies all these wants. The blood is a fluid in which the food and the oxygen and the waste materials are all contained.

Blood can be obtained for examination either by cutting an artery, or from a slight surface-wound which only opens capillaries, or from a vein. There is some difference in the blood as obtained from these three sources. Blood from an artery comes out in spurts, one for each heart-beat: such blood is bright scarlet in colour. Blood from a large vein pours or drips steadily without spurting: it is dark-bluish-red, like claret. Blood from the capillaries drips slowly and is between the other two in colour.



BLOOD CORPUSCLES

carry oxygen. This they do by means of a red colouring matter called hæmoglobin, which has the power of carrying oxygen and of giving it up again when in the presence of anything with a greater affinity for oxygen.

When blood is exposed to the air it absorbs oxygen, and then becomes bright scarlet. The blood in the arteries has recently been through the lung and has taken up oxygen from the air there. It gives up this in the capillaries, so blood from the capillaries is getting darker, and in the veins is darker still. The point is that blood containing oxygen is bright-red, and blood deprived of oxygen is dark.

If you draw some blood from any source and put it in a narrow glass vessel you find that it is a red opaque fluid, you cannot see light through it. In about five minutes you will find it has "clotted," turned into a jelly. You can then turn the vessel upside down and the blood will not flow out. Let it stand for half an hour, and you will find that the clot of jelly has shrunk and is floating in a clear yellow fluid. This fluid is called the *serum*.

This clotting of blood is a most important thing. But for this, we should bleed to death if we cut a finger. Some people's blood does not clot properly; they are called "bleeders" or "hæmophilics," and they suffer from severe loss of blood, and many of them die from slight wounds.

In health, when we cut ourselves, the blood clots in the cut ends of the blood vessels and stops the bleeding. In severe wounds this has to be helped by tying large blood vessels and pressing small ones flat by bandaging.

The clotting of blood is a very curious thing. It does not occur when the blood is in the blood vessels. It is not like the ordinary "setting" of a jelly, for that happens when you cool the jelly, but blood clots best at the heat of the body, and it can be delayed for a long time by putting the blood on ice.

The clot, when examined with a microscope, is found to consist of a number of fine threads; these threads are called *fibrin*.

—What it is, and does

We pointed out just now that if blood is kept on ice it does not clot for some time. In that case your tube of blood will change in appearance. Take a test tube, or thin glass tube closed at one end, fill it with fresh blood and put it on ice. The blood will gradually separate into two layers, a clear yellow fluid above and a thick red sediment below.

The fluid is called *plasma* when the blood has not clotted.

The red sediment at the bottom is made

up of *corpuscles* which are little red discs, which can be seen clearly with a microscope.

If you draw off the plasma from above the corpuscles and warm it, it will clot, and you will find the threads of fibrin in the clot. When blood clots, naturally the corpuscles are entangled in the blood.

Blood, then, is really a clear fluid, the plasma, in which are floating a great number of red corpuscles. When the blood clots, a change takes place in the plasma, threads of fibrin appear in it which entangle the red corpuscles, and after this change the plasma without the fibrin is called serum.

Let us take the corpuscles first; they are small discs, very small, each measures only $\frac{1}{3200}$ of an inch in diameter. If you prick your finger and smear the blood *very thinly* on a glass slide, and examine it under the microscope, you can see the round discs quite clearly.

The function of the corpuscles is to carry oxygen. They do this by means of a red colouring matter called *hæmoglobin* contained in them, which has the power of combining with oxygen and turning bright red when exposed to the air, and giving this up again and turning dark when in the presence of anything which has a greater affinity for oxygen (*see* Vol. III., p. 474).

Blood Corpuscles

If you take a glass syringe half full of blood, and put your finger over the nozzle and then pull the piston right out, you will produce a partial vacuum over the blood, and you will see bubbles of oxygen coming out of it. This is what happens in the muscles, they are burning up carbon, and require oxygen to do it, and the oxygen comes out of the hæmoglobin in the red blood corpuscles.

Besides the red corpuscles, there are others which are called white corpuscles, or *leucocytes*. They are much less numerous than the red corpuscles, there being only one white to every five hundred red. They are true cells, being masses of protoplasm containing a nucleus, which red corpuscles do not.

They are of two chief varieties called *polynuclear leucocytes*, which have an irregular-shaped nucleus, and *lymphocytes*, which have a round one. The former are like small specimens of the amœba described in Vol. III., p. 474. They move in the same way and can take up particles of foreign substance in the same way. This is one of their most important functions. They are the scavengers of the body; they swallow up small harmful things, more especially the germs which cause disease, and are of great value in preserving health, and also in recovery when such disease has occurred.

Lymphocytes are smaller and do not move independently.

The serum contains all the other important things in the blood. It consists chiefly of water, and about 9 per cent. of solids.

The solid it contains in greatest quantity is called *proteid*. We have spoken before of protoplasm as the material in cells which is alive, and if you take any tissue containing cells you can extract proteid. Proteid breaks up into soluble substances called *albumoses* and *peptones*, which, under certain gastric conditions, are themselves broken up into still simpler products.

Proteid

A familiar form of proteid is egg-albumen or white of egg. If you take a little white of egg in *cold* water and shake it up it will dissolve, but if you boil this water the proteid will go solid or coagulate and be precipitated. This is what happens when an egg is boiled or poached. There is *albumin* in serum, and if serum is boiled a precipitate of coagulated proteid will appear.

Besides the proteid, which makes up 9 parts per cent. of the blood serum, there is 1 part per cent. of salts. The chief are (1) sodium chloride (common salt), a combination of the metal sodium and the gas chlorine; (2) sodium carbonate, the same substance as washing soda, which is a combination of sodium and carbonic acid, and (3) sodium phosphate, a combination of sodium with phosphoric acid, which contains phosphorus.

These two last named salts, sodium carbonate and sodium phosphate, are of importance in absorbing carbon dioxide when produced by the muscles.

Besides the salts, the serum also contains small amounts of sugar, fat, and urea, which is a waste product containing nitrogen.

The blood thus contains all that is necessary for its functions. It has to bring food to the muscles, and for this it contains proteid, sugar and fat, which, as we shall see later, represent all the principal food stuffs.

The blood has to bring oxygen to the muscles. This it does in the hæmoglobin of the red corpuscles. It has to absorb carbon dioxide, and it does this through the sodium carbonate and sodium phosphate it contains.

Lastly it contains urea, which is another of the waste products.

The amount of blood in the body is said to be $\frac{1}{13}$ of the body weight, or about a pound for every stone of one's weight. A man weighing ten stone has rather more than ten pounds of blood in his body.

We have seen that the blood contains all these materials required for the body; but the blood is in the blood vessels and the muscle, and other cells are outside them. How do the materials get out of the blood to the muscles and glands?

A gland, for instance, consists of a tube, or series of tubes closed at one end, and open at the other, lined with secreting cells, and surrounded by a network of capillary blood-vessels.

Now the gaps between the gland cells and the capillary walls are not empty spaces, they are filled with fluid which is practically identical with blood plasma, but contains no red corpuscles.

This fluid is called lymph.

The Function of Lymph

Anything dissolved in the plasma, like sugar or carbon dioxide, can pass quite easily between the tissues and the blood vessels by way of the lymph.

For instance, if a muscle has been at work and is exhausted, its stock of sugar, which is an important muscle food, will be exhausted, and there is no difficulty in the sugar in the blood passing into the lymph surrounding the muscle and being absorbed by it.

In the same way the muscle is producing carbon dioxide in excess, and the lymph around the muscle is full of it. This carbon dioxide passes easily into the blood, in which there is comparatively little.

It is the same with the oxygen of the red corpuscles, but the corpuscles themselves, which are solid things, not dissolved but floating in the blood, do not, in health, pass out of the blood vessels.

This lymph which lies in among all the tissues is not stagnant, but has a sort of circulation of its own. It enters the lymphatic vessels, which are similar to veins, in which it passes slowly along from the extremities towards the heart. These vessels have valves inside them which allow the lymph to flow in this direction only. The lymphatics collect into a large trunk in the chest, the thoracic duct, and they finally open into the great vein which enters the upper side of the heart, the superior vena cava.

If one gets an inflamed finger, one sometimes sees a series of red lines running up one's arm; these mark the positions of the lymphatic vessels.

At the same time there will be tender lumps at the bend of the elbow and in the armpit, which are inflamed lymphatic glands.

Lymphatic Glands

Along the course of the lymphatics these glands are placed at intervals; they are collections of white blood corpuscles in a network of connective tissue enclosed in a connective tissue capsule. It is difficult to find them in health, but when inflamed they readily swell up. They act as filters to the lymph, and the white corpuscles in them try to destroy any harmful materials.

The lymphatics of the intestines are of great importance since the fat in the food is absorbed by their means.

The blood, then, consists of a fluid, the plasma, containing the red and white corpuscles. The blood will clot after being shed, when a substance called fibrin appears in it and entangles the corpuscles. The clot shrinks and squeezes out the serum.

The red corpuscles are discs containing hæmoglobin which can combine with oxygen. The white corpuscles are true cells and can swallow up harmful objects, if small enough.

The serum contains proteid, and salts in considerable quantity, and small amounts of sugar, fat and waste substances.

The spaces between the cells and the blood vessels is filled with a fluid which is like the plasma and called lymph. The lymph passes slowly towards the heart along lymphatic vessels, like veins, on which are placed lymphatic glands. D. W. C.-J.

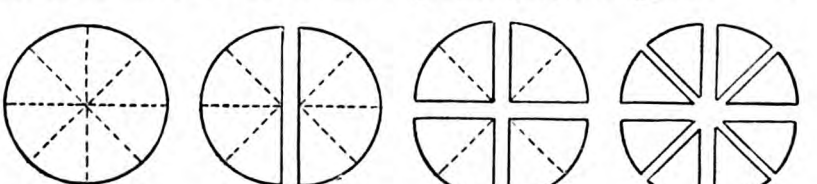
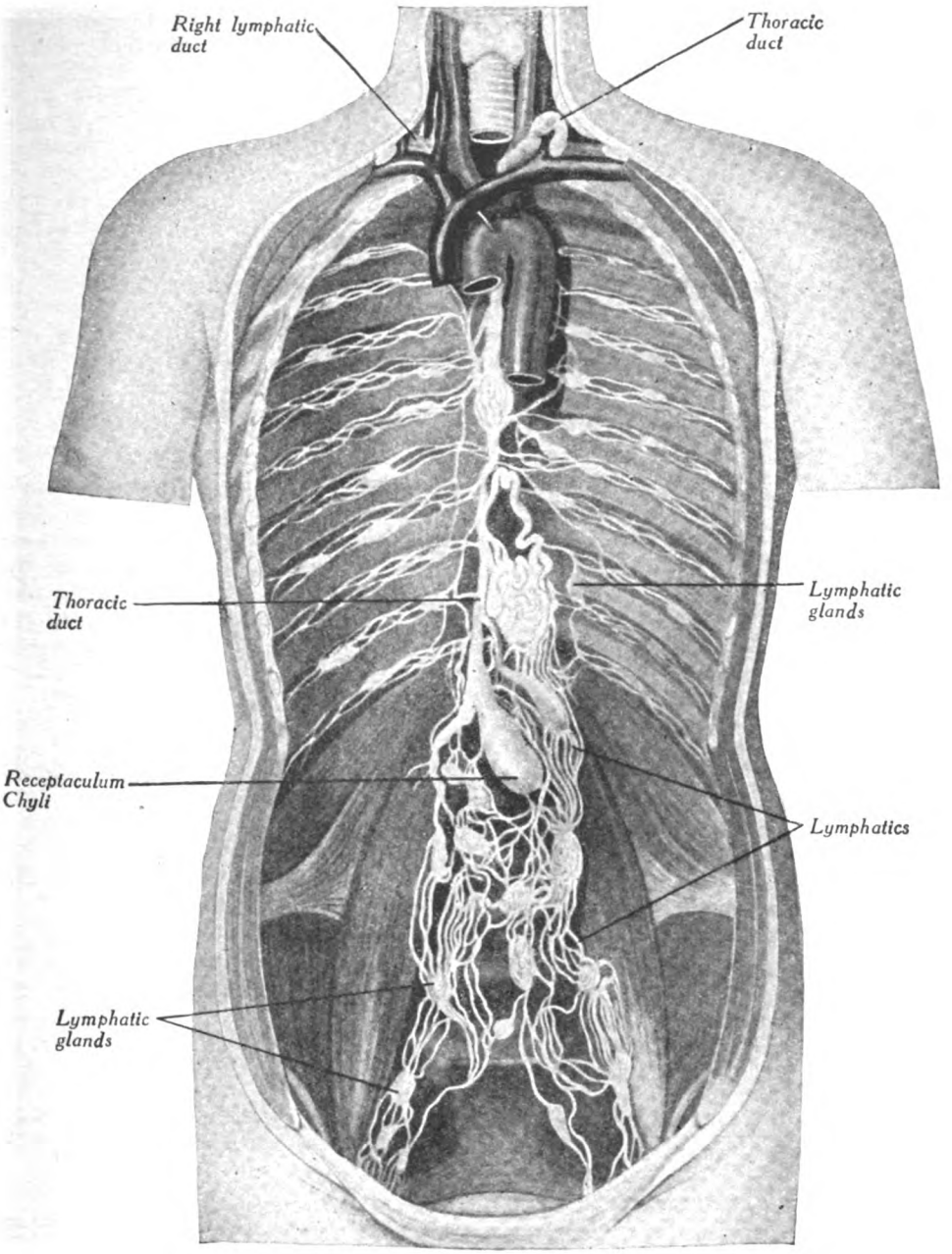


DIAGRAM SHOWING BREAKING UP OF PROTEIDS.



THE LYMPHATIC SYSTEM.

The spaces between the gland-cells and the capillary walls of the body are filled with lymph—a fluid similar to blood plasma but containing no red corpuscles. Anything dissolved in the plasma, like sugar or carbon dioxide, can pass quite easily between the tissues and the blood vessels by way of the lymph, which has a circulation of its own, passing slowly towards the heart along the vein-like lymphatic vessels, on which are placed valves, and glands at intervals.

Continued from page 419.

LANGUAGES:

***Contributors*:—LATIN, GREEK and FRENCH (E. A. Baker, M.A., D.Lit.). GERMAN (M. A. Lewenz, M.A.[Lond.]). SPANISH, RUSSIAN and ITALIAN (Alfred Calvert, First Prizeman in Modern Languages, R.S.A., London).**

LATIN.—XXX

Future Tense

(1) THE function of the future is the same in Latin as in English, to express an action that is expected to be performed, thus :—

Adveniet fausto cum sidere conjux.
The bride will come with favouring star.
Testis **erit** magnis virtutibus unda Scamandri.
The wave of Scamander will be witness to great deeds of valour.

(2) It is sometimes used, as in English, as a kind of imperative, thus :—

De nomine tu **videbis** cum Cispio.
You with Cispius will see about the account.

Future-Perfect

(1) The future-perfect expresses an action that will be completed at some future time, thus :—

Quae cum videro Roma decedam.
When I have seen these things I will depart from Rome.

(2) Sometimes, especially in early Latin, the future-perfect is used instead of the simple future. This usage gives a vividness similar to that attained by the use of the perfect for the future-perfect (*see* below). Examples :—

Si pergis, **abiero.**
If you continue, I shall be gone.
Tu invitas mulieres ; ego **accivero** pueros.
You invite the women ; I will immediately summon the boys.

Periphrastic Future

The future participle in **-ūrŭs** may be combined with the various tenses of **essĕ**, *to be*, to form a series of future tenses stating a purpose or expectation in present, past, or future time, according to the tense of the auxiliary. This future is most frequently employed with the subjunctive, which has no special form for the future. Examples :—

L. Cottam in iudicium **vocaturus est.**
He is about to summon L. Cotta to trial.
Cum tu advenis, **abiturus ero.**
When you arrive, I shall be about to go.
Si ausi essent, **dicturi fuerant.**
If they had dared, they had intended to speak.

Perfect Tense

The principal uses of the perfect are two-fold, to describe an action that was performed some time in the past, and to express an action that is complete at the time of speaking.

(1) The first use is the same as that of the Greek aorist or the English simple past ; thus, **ămāvī**, *I loved.* Example :—

Summa virtute **pugnavit.**
He fought with the utmost valour.

Used emphatically this may imply that something has ceased to exist, as in :—

Troia **fuit.**
Troy has been (but is no longer).
Filium **habui.**
I had a son (but he is no more).

(2) The second is the same as that of the Greek or English present-perfect ; thus, **ămāvī**, *I have loved* or *I have been loving.*

Abiit, excessit, evasit, erupit.
He has gone, has fled, has escaped, has broken out.

(3) The perfect may be used practically to express instantaneous or rapid action, especially in emphatic contrast with the present, as in :—

Terra tremit ; **fugere** ferae,
The earth begins to shake ; the wild beasts fled (at once).

(4) Sometimes the perfect is used for the sake of vividness instead of the future-perfect, as in :—

Brutus si conservatus erit, **vicimus.**
If Brutus shall have been saved, we have won.

This idiom is paralleled in English—
If things turn out as we expect, we have won.

Pluperfect Tense

The pluperfect expresses an action complete at some past time, thus :—

Romani qui caedibus **superfuerant,** in arcem confugiebant.
The Romans who had survived the slaughter, began to flee to the citadel.
Omnes qui orationem **audierant** clamabant.
All who had heard the speech, began to shout.

In letters it is employed, similarly to the imperfect, to describe something taking place before the time of writing. Here are some examples from Cicero's letters :—

Perpaucis ante diebus **dederam** Q. Mucio litteras ad te pluribus verbis scriptas.
A few days ago, I gave Quintus Mucius a letter for you, written at great length.
Meis litteris **declaraveram,** quo te animo censerem esse oportere.
I made clear in my letter of what mind I thought you should be.

The Moods

The examples given above of the various tenses are taken from the indicative mood. The function of the indicative is primarily to state something as a fact, that is, simply to assert or to deny. Like the English indicative, however, it has some other uses, appearing, for instance, in dependent clauses of conditional sentences, as will appear later.

The other moods, the imperative, the subjunctive, and the infinitive (which is in reality a verbal substantive) require special consideration. Let us take the imperative first.

Imperative Mood

The function of the imperative is to express a command. Commands may also be expressed by the subjunctive, but in a less peremptory way. Prohibitions, or commands not to do something, are rarely expressed in the imperative in good prose, but usually go in the subjunctive with **nē** (*see* below). The future imperative differs from the simpler form (which refers equally to the future) and expresses a command in a more formal and authoritative way, and is chiefly found in legal phraseology. Examples of the imperative are :—

Tityre, dum redeo (brevis est via), **pasce** capellas, et potum pastas **age.**
Tityrus, while I am on my way back (short is the road), feed the goats, and when you have fed them, drive them to water.
Aequam **memento** rebus in arduis servare mentem.
Remember to keep an even mind in adversity.
Cura ut valeas.
Take care to be well.
Borea flante ne **arato.**
When the north wind blows do not plough.

Subjunctive Mood

The correct use and understanding of the subjunctive present most difficulty to the student in dealing with the Latin verb. In our own language we have no parallel to its subtleties of meaning, the English subjunctive having for centuries fallen into wellnigh complete desuetude. The student must therefore follow this analysis of its various uses with special attention. These uses of the subjunctive will be classified under their distinct heads ; but the student should remember throughout the essential fact that " the subjunctive, as distinguished from the indicative, expresses an event or action as thought or supposed rather than as done or narrated." This truth applies to the subjunctive whether used in simple sentences or in dependent clauses.

The subjunctive has two main uses in principal sentences (1) the jussive use, and (2) the hypothetical use, that is in the apodosis of conditional sentences. The first of these only will be treated now, the hypothetical use being deferred until we deal with conditional sentences.

The use of the subjunctive in principal sentences falls under three main heads, all of which may be grouped under the head of the jussive subjunctive. These heads are (1) the jussive use proper, expressing commands, prohibitions, and exhortations ; (2) the optative use, expressing wishes ; and (3) the deliberative use, expressing questions or doubts as to courses of actions to be adopted or events regarded as possible.

1. The jussive subjunctive proper expresses a request, a command, or an exhortation. It is used in the present tense (or the perfect in prohibitions), in the first person plural, the third person singular or plural, and, indefinitely, in the second person singular. The negative in prohibitions is always **nē.** Examples :—

Linquamus naturam artesque videamus.
Let us leave nature alone and regard the arts.
Hoc **faciat.** *Let him do this.*
Ne **exeat.** *Let him not depart.*
Nec **cupias,** nec metuas. *Neither desire nor fear.*

When a prohibition is not general but definite and addressed to a particular person the second person of the perfect subjunctive is used, as in :—

Ne **transieris** Iberum : ne quid rei tibi **sit** cum Saguntinis.
Do not cross the Ebro ; let there be no dealings between you and the Saguntini.

2. The optative subjunctive expresses a hope or wish. It is often preceded by the adverb **ŭtīnam.** The negative used is always **nē.** A wish that is regarded as able to be realised is put in the present tense, thus :—

Valeas, amice. *Farewell, my friend.*

Omnes boni cives felices **sint.** — *May all good citizens be happy.*

Ne **sim** salvus, si aliter scribo ac sentio.
May I not be saved, if I write otherwise than I think.

When the wish is that something might be different from what it actually is, the imperfect subjunctive is used, thus :—

Homo hic ebrius est. Utinam ita **essem.**
This man is drunk. I wish I were.

When the wish is that something had been different from what it was, the pluperfect subjunctive is used, as in :—

Utinam, Cn. Pompei, cum Caesare societatem nunquam **coisses** aut nunquam **diremisses.**
I would, Cnaeus Pompeius, you had either never entered into an alliance with Caesar or else had never broken it off.

3. The deliberative subjunctive is used in questions or doubts as to contemplated actions or events. The negative in this case is **nōn.** When the action or event contemplated is something that might happen, the present subjunctive is used, thus :—

Velim in Italiam proficisci.
I could wish to set out for Italy.

When the action or event contemplated is something that might have happened, the imperfect is used, as in :—

Haec cum viderem, quid **facerem**?
When I saw these things, what was I to do?

Exercise 29

Translate into English :—

1. Quid hoc homine facias? 2. Non idem imperassem omnibus per diversa aegrotantibus. 3. Praecipitatem igitur impellamus et perditum prosternamus. 4. Quam ob rem hos quidem ab hoc sermone removeamus. 5. Ipsi autem intelligamus natura gigni sensum diligendi et benevolentiae caritatem, facta significatione probitatis. 6. Cum iis qui in foro habitarunt de dignitate contendas?

Translate into Latin :—

1. What is going to become of my little Tullia? 2. The wolf of his own free will might flee from the sheep. 3. I would that I were not writing the truth! 4. When you receive (this) letter at the hands of my secretary, judge that I have had not even a moment of leisure. 5. For you would have had, not a guest, but a house-mate. 6. I will do what you desire as well as I can (shall be able).

E. A. B.

FRENCH.—XXX

THE **Subjunctive Mood** is used to express, not facts, but imaginary or dependent propositions. Its uses may be classified as follows :

(1) After verbs expressing desire, command, request, necessity, as in—

Je permets, je souhaite, je veux, j'ordonne, que vous veniez, — *I permit, I wish, I desire, I order, that you should come.*

Il faut que vous veniez, — *You must come.*

(2) After verbs expressing fear, doubt, or uncertainty, as in—

Il n'est pas certain que vous ayiez raison, — *It is not certain that you are right.*

Je crains, je tremble, j'ai peur, j'appréhende, qu'il ne vienne, — *I fear, I tremble, I am afraid, I apprehend, that he may come.*

(3) After most verbs in the interrogative or negative form, as in—

Je ne crois pas qu'il vienne, — *I do not think that he will come.*

Note that choice of the indicative or of the subjunctive depends upon the nature of the doubt expressed. If this tends towards the affirmative, the indicative would be preferred; if towards the negative the subjunctive would be more suitable.

(4) After verbs of preventing, avoiding, etc., as in—

Cela n'empêche pas qu'il vienne, — *That does not prevent him from coming.*

(5) After **qui**, **que**, **lequel**, **dont**, **où**, preceded by an adjective in the superlative, or an adjective having the import of a superlative, as **le seul**, **le premier**, **le dernier**, etc., thus—

La meilleure chose que vous puissiez faire, — *The best thing that you can do.*

C'est le seul que je connaisse, — *He is the only one I know.*

(6) After the conjunctions given in the preceding lesson, **afin que**, *in order that*, **à moins que**, *unless*, etc., as in—

Je l'ai envoyé ici afin qu'il vous voie, — *I sent him here to see you.*

(7) After the following conjunctions when they express purpose or result: **de façon que**, **de manière que**, **de sorte que**, *so that*, **jusqu'à ce que**, *till that, until*, as in—

Jusqu'à ce qu'il vienne, — *Until he comes.*

The question whether the subjunctive is or is not to be used in a particular sentence can be determined only by analysis of the meaning of the sentence. It must be determined whether the statement is made as an affirmation of fact, or is merely an expression of doubt, desire, purpose, etc. The same construction may be followed by either the indicative or the subjunctive, according to the mental attitude of the speaker or writer. Thus, *I do not believe he will come* may be translated **je ne crois pas qu'il vienne**, if the idea of doubt is uppermost, or **je ne crois pas qu'il viendra**, if a simple affirmation of disbelief is intended.

The impersonal **il est** followed by **sûr**, *sure*, **certain**, *certain*, **vrai**, *true*, **démontré**, *proved*, **évident**, *evident*, etc., used in a

positive and affirmative sense, takes the indicative, thus—

Il est certain qu'il vient ou qu'il viendra,	*It is certain that he is coming or will come.*

When this construction is used negatively or interrogatively, either the indicative or the subjunctive may be employed, thus—

Il n'est nullement certain qu'il vienne *or* qu'il viendra *or* qu'il est venu,	*It is by no means certain that he is coming, will come* or *has come.*

The verbs **croire**, *to believe*, **espérer**, *to hope*, **gager**, **parier**, *to bet*, **penser**, *to think*, **sentir**, *to feel*, **voir**, *to see*, and others expressing positive affirmation, are, in the affirmative sense, followed by the indicative present or future, as in—

Je pense, je crois, je dis qu'il viendra,	*I think, I believe, I say that he will come.*

The learner may with advantage study the following further examples of the use of the indicative and subjunctive, discovering for himself the element of positive affirmation or that of doubt determining which mood should be used :—

J'ai un homme qui me rendra service,	*I have a man who will oblige me.*
J'ai besoin d'un homme qui me rende service,	*I want a man who will oblige me.*
Voilà le seul chapeau que j'ai,	*That is the only hat I have.*
Voilà le meilleur homme que je connaisse,	*There is the best man I know.*
Je crains qu'il ne tombe,	*I am afraid that he may fall down.*
Je tremble qu'il n'arrive pas à temps,	*I am in fear lest he may not arrive in time.*
Il faut que vous restiez ici,	*You must stay here.*
Obéis, si tu veux qu'on t'obéisse un jour,	*Obey, if thou wishest some day to be obeyed.*
Je ne pense pas qu'il vienne,	*I do not think that he will come.*
Je ne pense pas qu'il vient,	*I do not think that he is coming.*
Croyez-vous qu'il vienne ?	*Do you think that he will come ?*
Quelque effort que fassent les hommes, leur néant paraît partout,	*Whatever effort men may make, their nothingness appears everywhere.*
Qui que ce soit, parlez et ne le craignez pas,	*Whoever he be, speak, and do not fear him.*
Si mince qu'il puisse être, un cheveu fait de l'ombre,	*However thin it be, a hair throws a shadow.*
Y a-t-il quelqu'un qui ne respecte le malheureux ?	*Is there any one who does not respect the unfortunate ?*

VOCABULARY

alléguer, *to allege.*
l'artisan, m., *the mechanic.*
assurer, *to make certain.*
le cas, *the case*, en cas, *in case.*
les dépens, *the expense.*
éblouir, *to dazzle.*
élever, *to raise, exalt.*
s'enrichir, *to enrich oneself.*
fâcheux, *unfortunate, annoying.*
la faveur, *the favour.*
le fusil, *the gun.*
malsain, *unhealthy.*
la misère, *misery, poverty.*
le négociant, *the financier.*
ordonner, *to order, command.*
persister, *to persist.*
plaider, *to plead.*
le portier, *the porter.*
se rendre, *to go, attend.*
réussir, *to succeed.*
la santé, *health.*
tirer, *to shoot, to fire.*

Exercise 57

1. Pensez-vous que vous réussissiez dans cette affaire ? 2. Je ne voudrais pas assurer qu'on doive l'écrire. 3. Dès ce même moment ordonnez que je parte. 4. Tu veux qu'en ta faveur nous croyions l'impossible. 5. Il est temps que vous partiez pour Rome. 6. Il ne me plaît pas que vous alliez là. 7. Quoique à peine à mes maux je puisse résister, j'aime mieux les souffrir que de les mériter. 8. Il n'est pas nécessaire que vous finissiez cette histoire. 9. En cas que vous persistiez, il faut que j'allègue au prince et même au roi votre mauvaise santé. 10. Il se conduisait très-mal, de sorte qu'il fût contraint de se retirer. 11. Faites en sorte qu'on soit content de vous. 12. Puisqu'on plaide, qu'on meurt, et qu'on devient malade, il faut des médecins, il faut des avocats. 13. Si vous partez, et que vous vouliez me prendre avec vous. 14. Fais du bien aujourd'hui puisque tu vis encore.

Exercise 58

1. It is right that you should pay what you borrowed. 2. It is a great pity that he should have forgotten himself so. 3. I will remain until you have settled your affairs. 4. Do you think that this cloth will wear well ? 5. I believe that our porter will not delay long. 6. Do you believe that those students can learn by heart five pages in two hours ? 7. I believe it is impossible. 8. Do you think that this financier is enriching himself at our expense ? 9. I know that he enriches himself at the expense of others. 10. Do you think that the concert will take place to-day ? 11. I believe that it will not take place. 12. Would you like me to buy a coat that is half-worn ? 13. I should like you to buy a new one.

Key to Exercise 51

1. Bread and water are enough for him. 2. Bring us salt and vinegar. 3. Let us propose to ourselves rather to imitate great examples than to follow vain systems. 4. Fortunate would it have been if in his time Macedonia had had lunatic asylums. 5. A multitude of nations. 6. Of what use so many friends ? A single one is enough if he loves us. 7. Many of the persons that I have seen. 8. Never give advice that it is dangerous to follow. 9. We never can do good towards God in doing evil to men. 10. The father and mother seemed to encourage their little companion to feed upon it first. 11. I have seen many other countries. 12. The wise and pious Fénelon has well-established rights to general esteem. 13. The cheeks or sides of the head are covered with black down. 14. The more useful an action, the more praiseworthy it is. 15. Your sister did not weep, although she was the most grieved of all those ladies. 16. Your sister does not weep, even when she is most grieved. 17. I know no Spanish novel or comedy without combats. 18. The good taste of the Egyptians made them like solidity and unadorned regularity. 19. The smile is a mark of goodwill, of applause, of inward satisfaction.

E. A. B.

RUSSIAN.—XVII

The Adverb

212. The Adverbs are classified into qualitative, quantitative, and circumstantial.

213. Qualitative Adverbs are really predicative neuter Adjectives, and have like them the same degrees of comparison. See Lesson XIII., rules 147-150 and 151.

Examples

	As Adjectives.	*As Adverbs.*
Хорошо́,	*good,*	*well.*
Краси́во,	*nice,*	*nicely.*
Прекра́сно,	*beautiful,*	*beautifully.*
Привлека́тельно,	*attractive,*	*attractively.*
Ва́жно,	*important*	*importantly.*
Откровéнно,	*candid,*	*candidly.*
Плóхо,	*bad,*	*badly.*
Некраси́во,	*ugly,*	*uglily.*
Га́дко,	*ugly,*	*uglily.*
Отврати́тельно,	*repulsive,*	*repulsively.*
Смѣшнó,	*ridiculous,*	*ridiculously.*
Хи́тро, лука́во,	*cunning,*	*cunningly.*

214. The quantitative Adverbs relate to quantity, size, bulk or extent.

Examples

Мнóго, *much.*	Мáло, *little.*
Довóльно, *enough.*	Недостáточно, *insufficient.*
Стóлько, *so much.*	Нѣсколько, *some.*
Два́жды, *twice.*	Три́жды, *thrice.*
Во-пéрвыхъ, *firstly.*	Во-вторы́хъ, *secondly.*
Одна́жды, *once.*	Разъ, *one time.*

215. The Circumstantial Adverbs cover a wide range of words used to describe the circumstances under which action took place or some state was produced.

Examples

Relating to time:

Сегóдня, *to-day.*	Отны́нѣ, *from now, from to-day.*
За́втра, *to-morrow.*	Вчерá, *yesterday.*
Всегдá, *always.*	Пóслѣ-за́втра, *the day after to-morrow.*
Рáно, *early.*	Никогдá, *never.*
Постоя́нно, *continually.*	Пóздно, *late.*
Ежедне́вно, *every day.*	Вѣчно, *eternally.*
Ежемѣсячно, *every month.*	Еженедѣльно, *every week.*
Ны́нѣ, ны́ньче, *now-a-days.*	Ежегóдно, *every year.*
Потóмъ, затѣмъ, пóслѣ, *after.*	Сперва́, *first.*
Давнó, *long ago.*	Прéжде, *before.*
Ещё не . . . *not yet*	Уже́, *already.*
Когдá, *when.*	Тогдá, *then.*
Иногдá, *sometimes.*	Тепéрь, *now.*
Сейчáсъ, *just now.*	Тотчáсъ, *the very moment.*

Relating to place:

Здѣсь, *here.*	Внутри́, *inside.*
Сюдá, *hereto, hither.*	Вверху́, *on the top.*
Близъ, бли́зко, *near.*	Тамъ, *there.*
Óколо, вокру́гъ, *round about.*	Тудá, *thither.*
Гдѣ, *where.*	Далекó, *far.*
Откýда, *where from.*	Кудá, *where to.*
Отсю́да, *from here.*	Оттýда, *from there.*
Вездѣ́, повсю́ду, всю́ду, *everywhere.*	Нигдѣ́, никудá, *nowhere.*
Спéреди or спереди́, *from the front.*	Сза́ди, *from behind.*
Вперёдъ, *forward.*	Внизу́, *at the bottom.*
Напрáво, *to the right.*	Назáдъ, *backward.*
Дóма, *at home.*	Налѣво, *to the left.*
	Домóй, *homeward.*
	Снаружи, *from outside.*

Relating to cause and effect:

Почемý, *why?*	Потомý, поэ́тому, *therefore.*
Отчегó, *why?*	Оттогó что, *because.*
Зачѣмъ, *for what reason.*	Затѣмъ что, *for the reason that . . .*
Согла́сно, *in accordance with.*	Слѣдовательно, *consequently.*
Относи́тельно, каса́тельно, *regarding, with reference to.*	

Relating to ways and means:

Какъ, *how.*	Неусы́пно, *tirelessly.*
Посре́дствомъ, *by means of.*	Такъ, *so.*
Кста́ти, *in the proper time, place, case.*	И́наче, *otherwise.*
Мимохóдомъ, *by the by.*	Весьмá, óчень, *very.*
Дáромъ, *for nothing.*	Напрáсно, тщётно, *vainly.*
Основа́тельно, *thoroughly.*	Тща́тельно, *carefully.*
Осторóжно, *cautiously.*	Бере́жливо, *with thrift.*
Экономи́чно, *economically.*	Неради́во, небре́жно, *carelessly, neglectfully.*
Расточи́тельно, *squanderingly, dissipatingly.*	Пове́рхностно, *superficially.*
	Рѣши́тельно, *decidedly.*

216. The following Adverbs govern the Genitive:

Близъ, *near.*	Óколо, *round.*
Пове́рхъ, *above.*	Вмѣсто, *instead.*
Кромѣ, *except.*	Проти́въ *or* прóтивъ, *against.*
Внутри́, *inside.*	Внѣ, *outside.*
Среди́, *in the midst of.*	Вдоль, *along.*
Вóзлѣ, *near by.*	Ми́мо, *past, by.*
Пóслѣ, *after.*	Мáло, *little.*
Мнóго, *much.*	Достáточно, *sufficiently.*
Довóльно, *enough.*	Нѣсколько, *some.*
Стóлько, *so much.*	Недостáточно, *insufficiently.*
Немнóго, *a little.*	Впереди́, *in front.*
Вокру́гъ, *round.*	Позади́, *behind.*
Относи́тельно, *regarding.*	Каса́тельно, *concerning.*
Посре́дствомъ, *by means of.*	

217. The following govern the Dative:

Вопреки́, *in spite of.*	Согла́сно, *according to.*

VOCABULARY

NOTE.—Words clear from the transverse English text of the Reading Exercise have, for the sake of economising space, been omitted from the Vocabulary.

Приблизи́тельно, *approximately, something about.*	Пріохóтить (P.), *to induce, incline.*
Отказáться (P.), *to resign.*	Влóженъ, *enclosed.*
Глáвный Управля́ющій, *general manager.*	Относи́вшіеся, *relating to.*
	Указáніе, *stating.*

Заложи́ть (P.), *to found, establish.*
Со́бственное, *one's own.*
Пребыва́ніе, *the stay.*
Торго́выя дѣла́, *trade, commerce.*
Ва́жный, *important.*
Исто́чникъ, *source.*
Вознамѣ́риться (P.), *to have the intention.*
Занима́ться (Imp.), *to occupy oneself, to carry on.*
Мѣ́стность, *place, district.*
Составля́ть (Imp.), *to form, make.*
Господствующій, *the predominating, staple.*
Значи́тельный оборо́тъ, *considerable turnover.*
О́трасль, *branch, line, speciality.*
Есте́ственно, *naturally.*
Идётъ рѣчь, *is being spoken of.*
Къ тому́, *besides, moreover.*
Помога́ть, *to assist, help.*
Дѣ́лать запа́сы, *to cater.*
Успѣ́шно, *successfully.*
Спосо́бствовать (Imp.), *to help.*
Дѣ́ланіе, *the making.*
Яви́ться (P.), *to appear as.*
Необходи́мость, *a necessity.*
Да́бы, *in order to.*
Гаранти́ровать себя́ отъ, (Imp.), *to protect oneself against.*
Поддержи́ваніе, *the maintenance.*
Сопряжённый, *connected.*
Сноше́нія, *relations.*
При, *in.*
Приходи́ться (Imp.), *to happen, to be driven to.*
Счита́ться (Imp.), *to reckon with.*
Серьёзный, *grave, serious.*
Ула́живаніе, *the settling of, smoothing over.*
Возни́кнуть (P.), *to arise.*
Недоразумѣ́ніе, *misunderstanding.*
Обстоя́тельство, *circumstance.*
Въ распоряже́ніи, *at the disposal.*
Быть радъ, *to be glad.*
Пусти́ться (P.), *to embark on.*
Сообща́, *conjointly.*
По́лное оправда́ніе, *meeting, justifying in full.*
Возмо́жный, *possible, probable, feasible.*
Обяза́тельство, *obligation, liability.*
Чу́вствовать себя́ (Imp.), *to feel oneself.*
Обезпе́ченный, *safe, secure.*
Отноше́ніе, *respect.*
Переда́ть (P.), *to hand over.*
Нала́ть (P.), *to give it, form into.*

Указывать (Reit), *to point out.*
Разме́ръ, *rate.*
Скида́ка, *discount, allowance.*
На мѣ́стѣ, *on the spot.*
Содержа́ть, *to contain.*
Руково́дство, *guidance.*
Спустя́, *after the lapse of, after the course of* (with Acc.).
Вскры́вать (Imp.), *to open.*
Опи́сывать (Imp.), *to describe.*
Я́сно, *clear.*
Поня́тно, *explicit.*
Вы́ставить перево́дъ (P), *to draw a draft.*
Должне́ствовать (Imp.) (*to owe*), *ought, to have to.*
Опла́чивать (Imp.), *to pay off.*
Ве́ксель, *bill of exchange.*
Подо́бный, *such.*
Упла́та, *payment.*
Обыкнове́нно, *usually.*
Учи́тываться, *to be negotiated, discounted.*
Учётный курсъ, *discount rate.*
Въ зачётъ, *on account.*
Причита́ться (Imp.), *being due, owing.*
Сочета́ть (Imp.), *to combine.*
Быть запа́ленъ рабо́той, *to be overwhelmed with work.*
Наблюда́ть (Imp.), *to attend to, look after.*
Экспеди́ція, *shipping, forwarding.*
Отдѣ́лываться (Imp), *to be prepared, made up.*
Въ соотвѣ́тственность, *to suit.*
Вкусъ, *the taste.*
Предназна́чаться (Imp)., *to be destined for.*
При э́томъ, *thereby.*
Счита́ть (Imp.), *to think, deem.*
Нели́шнимъ, *not out of place.*
Выраже́ніе, *expression, term.*
Разумѣ́ть (Imp.), *to mean, understand.*
Завёртываніе, *the wrapping up.*
Производи́ть (Imp.), *to carry on.*
Разме́ръ, *scale, dimension.*
Вскрыва́ться (Imp.), *to get opened.*
Обезпе́чивать себя́ (Imp.), *to shield, protect oneself.*
подверга́ть себя́ (Imp.), *to subject oneself to, expose oneself to.*
Одолжи́ть (P.), *to lend, borrow, do a favour.*
Гото́въ, *ready, prepared.*
Оконча́тельный, *final.*
Прiобщи́ться (P.), *to join.*
Кой-како́е, *any.*

Зако́нная фо́рма, *legal shape, form.*
Вслѣ́дъ затѣ́мъ, *immediately afterwards.*
Служе́бный персона́лъ, *the staff.*
Обя́занность, *the duty.*
Предвари́тельно, *preliminarily to.*
Ну, *well.*
Исчисля́ть (Imp.), *to set forth, specify.*
При рабо́тѣ съ, *by dealing with.*
Быть по́лонъ надёжд, *to be full of hopes.*
Да́же, *even.*
Разъѣ́зды, *travels, journeys.*
Затѣ́мъ, *subsequently, afterwards.*
Управле́ніе, *management.*
Слу́чай, *chance, opportunity.*
Обогаще́ніе, *enriching.*
Прiобрѣте́ніе, *acquisition, acquiring.*
Свѣ́дѣніе, *information.*
Мно́жество, *multitude, variety.*

Располага́ть (Imp.), *to own, dispose of.*
Неминуе́мо, *unavoidably.*
Полага́ть (Imp.), *to suppose, think.*
Предвиде́ть (Imp.), *to foresee.*
Запи́ска, *a note, memorandum.*
Въ виду́, *in view.*
Въ ка́чествѣ, *in the shape, quality.*
шагъ, *step.*
По нахожде́ніи, *on finding.*
Состоя́ть (Imp.), *to consist of.*
Гла́внымъ о́бразомъ, *mainly.*
Учрежде́ніе, *founding, establishing.*
Содержа́щій, *containing.*
Излага́ть (Imp.), *to set forth, point out.*
Бывъ, *having been.*
Включа́ть (Imp.), *to include, enclose.*
То́чно, *precisely.*
Иносе́мный, *foreign, of foreign land.*

Reading Exercise

(*Liberally rendered into Russian*)

1. При учрежде́ніи экспо́ртной конто́ры мы заключа́емъ ме́жду това́рищами догово́ръ това́рищества, нанима́емъ персона́лъ, включа́я волжёра, разсыла́емъ ра́зные обра́зчики за грани́цу, получа́емъ зака́зы и по выполне́ніи таковы́хъ посыла́емъ на́шимъ зака́зчикамъ това́ры запако́ванными въ тю́кахъ, я́щикахъ, свя́зкахъ, коро́бкахъ, бо́чкахъ и про́чее

1. In establishing a shipping house, we draw up a deed of partnership between the partners, engage staff, including traveller, send various patterns abroad, receive orders, ship the goods, when the orders are executed, packed in bales, cases, trusses, crates, barrels, etc., to our clients.

2. Пе́редъ вы́дачей на́шимъ кліе́нтамъ това́ры разсма́триваются на иностра́нной тамо́жнѣ и за нихъ упла́чиваются по́шлины, согла́сно описа́нію, да́нному въ обыкнове́нномъ и́ли ко́нсульскомъ счётѣ.

2. Before being delivered to our customers the packages are examined in the foreign custom house and duty is paid on them, according to the description given of them in the regular or consular invoice.

3. Счётъ соде́ржитъ всѣ́ расхо́ды по упако́вкѣ, отпра́вкѣ, застрахова́нію, и про́чее, и въ нёмъ вы́ражены усло́вія, ука́зывающія, каки́мъ о́бразомъ платежи́ должны́ быть произведены́.

3. The invoice contains all the charges for packing, forwarding, insurance, etc., and the terms are stated showing how payment has to be made.

4. Това́ры включа́ютъ въ себѣ́ маши́ны, бакале́йные това́ры, желѣ́зныя издѣ́лія, мануфакту́рные това́ры, какъ то: суро́выя, отбѣ́ленныя, окра́шенныя и наби́тыя хлопча́тобума́жныя издѣ́лія, льняны́я, шерстя́нные и пенько́вые това́ры, какъ равно́ и пря́жу, такъ что мы должны́ имѣ́ть по́лное поня́тіе о пряде́ніи, тка́чествѣ, отбѣ́ливаніи, бума́го-набива́ніи и окра́шиваніи мате́рій.

4. The goods include machinery, comestibles, hardware, dry goods, such as textiles, i.e., grey, bleached, dyed, printed cottons, linen, woollens, hemp, also yarn, so that we require a general knowledge of spinning, weaving, bleaching, printing, and dyeing.

5. Намъ прихо́дится и́ли назнача́ть цѣ́ны то́лько за са́мый това́ръ и́ли же включа́ть въ нихъ изве́стные расхо́ды, такъ что мы должны́ быть то́чно освѣ́домлены́, да́бы не сдѣ́лать цѣ́ны сли́шкомъ высо́кой или ни́зкой.

6. Въ на́шей конто́рѣ намъ предстои́тъ наблюда́ть за всѣ́ми счета́ми, выпи́сывать факту́ры, тра́тты, отправи́тельскія распоряже́нія для на́шихъ экспедито́ровъ, вести́ Гла́вную кни́гу, Журна́лъ, Ка́ссовую кни́гу, Дне́вникъ и ежедне́вно перепи́сываться со всѣ́ми страна́ми све́та.

7. Дѣ́ла не всегда́ иду́тъ какъ по ма́слу, такъ какъ мы иногда́ имѣ́емъ дѣ́ло съ шикане́рами, моше́нниками, зло́стными и несча́стными банкро́тами. Намъ постоя́нно прихо́дится напомина́ть на́шимъ ме́дленнымъ плате́льщикамъ объ ихъ долга́хъ и проси́ть ихъ, что́бы они́ упла́чивали намъ на́ши де́ньги. Весьма́ ча́сто намъ прихо́дится дово́льствоваться то́лько ча́стью того́, что намъ слѣ́дуетъ, и разсро́чить остальну́ю су́мму на до́лгіе промежу́тки. Пролонги́рованіе неопра́вданныхъ креди́товъ, наложе́ніе аре́стовъ на това́ры въ обезпе́ченіе платеже́й и другія подо́бныя непріа́тныя пра́ктики поро́ю дѣ́лаютъ на́шу жизнь пря́мо бре́менемъ и постоя́ннымъ кошма́ромъ.

8. Но мы имѣ́емъ та́кже и свои́ счастли́выя мину́ты (happy moments). Это быва́етъ тогда́, когда́ (this happens then, when) на́ши покупа́тели и́ли пріѣзжа́ютъ сюда́ за това́ромъ. Мы прово́димъ (spend) тогда́ на́ше вре́мя съ ни́ми о́чень ве́село (cheerfully), стара́ясь сдѣ́лать ихъ пребыва́ніе въ на́шемъ го́родѣ какъ мо́жно комфортабе́льнѣе. На́ше ли́чное свида́ніе (personal intercourse) вдоба́вокъ ока́зывается (proves in addition) о́чень выгоднымъ для насъ, такъ какъ (because) покупа́тели зака́зываютъ для свои́хъ рынко́въ лу́чшій това́ръ и да́ютъ намъ лу́чшія цѣ́ны.

9. По́лнымъ интере́сностью стано́вится (becomes) для насъ на́ше дѣ́ло (business) тогда́, когда́ нашъ вояжёръ, соверша́я свое́ пе́рвое путеше́ствіе заграни́цей (on making his first voyage abroad), дѣ́лится съ на́ми свои́ми впечатлѣ́ніями и всѣ́мъ (shares with us his impressions and all), что онъ ви́дѣлъ и замѣ́тилъ на своёмъ пути́, опи́сывая жизнь на парохо́дѣ (describing the life on the steamer), свой прі́ѣздъ въ чужу́ю стра́ну, его́ изумле́ніе всему́, что онъ нашёлъ (he has found) нови́мъ и иначе, чѣ́мъ на ро́динѣ, его́ пе́рвыя завя́зки сноше́ній (literally: tying of connections) съ покупа́телями въ ихъ родно́мъ нарѣ́чіи (in their native dialect or idiom), ра́зные обы́чаи, существу́ющіе въ иностра́нныхъ конто́рахъ и магази́нахъ, полити́ческую и религіо́зную жизнь въ тѣ́хъ краяхъ, ихъ неусто́йчивые би́ржевые ку́рсы, перево́роты и мно́жество други́хъ стра́нныхъ и любопы́тныхъ фа́ктовъ.

10. Въ заключе́ніе мы чу́вствуемъ, что всё, относя́щееся къ э́тимъ предме́тамъ, должно́ оказа́ться осо́бенно поле́знымъ и интере́снымъ для студе́нта на́шего Ру́сскаго ку́рса. Оста́льная часть сего́ ку́рса бу́детъ гла́внымъ о́бразомъ посвящена представле́нію ра́зныхъ фа́зисовъ экспо́ртнаго дѣ́ла. Для послѣ́дующихъ уро́ковъ для чте́нія и упражне́ній мы избра́ли загла́віемъ: "МА́НЧЕСТЕРСКАЯ ЭКСПО́РТНАЯ КОНТО́РА."

5. We have to quote prices for the goods alone, or to include certain charges, so that we must have precise information, in order not to make the price too high or too low.

6. In our offices we have to draw up all the accounts, make out invoices, drafts, shipping advices to the shipping agents, keep the ledger, journal, cash-book, day-book, and correspond daily with all parts of the world.

7. The course of business does not always run smooth, and so we have sometimes unpleasant dealings with chicaneurs (bogus claim-makers), defaulters, bankrupts, fraudulent or the victims of circumstances; we have to dun continuously to get our money from slow payers, and often have to accept part of what is due to us, instead of all, spreading the balance over long intervals in the shape of dividends. What with these so-called compositions, having to grant extensions of credit, laying embargo on goods to secure payment, and other disagreeable transactions, our life sometimes becomes a burden to us, and a continual nightmare.

8. A pleasanter subject to touch on is the arrival here of our customers for the purpose of making purchases, when we try to give them a "good time," that is, we do our best to make their stay in our city a pleasant one, besides being a profitable one for ourselves, through the remunerative prices at which we sell them suitable and first-class goods for their markets.

9. Another topic full of interesting matter is that of our traveller's first journey abroad, detailing his experiences aboard the outward steamer, his arrival on foreign ground, his wonder at all he sees new and different in every way from the mother-country, his first dealings with foreign buyers in their own language, the different customs followed in offices and stores, political and religious life, rates of exchange constantly varying, revolutions, and scores of strange and curious things.

10. In conclusion, we feel that everything bearing upon these matters must prove highly useful and interesting to our Russian student, and the rest of our little course will therefore be mainly given up to the different phases of the export business generally known under the head of the "shipping trade." For the title of our Readings and Exercises, we will take the heading: "A Manchester Shipping House."

Reading Exercise —II

A Manchester Shipping House.

Experiences of a Manchester Shipping Merchant.

1. Some twenty years ago I decided to resign my position as general manager in a Manchester export house.

2. Then I established myself, along with an old friend, on my own account.

3. Here, in Manchester, and during many years abroad, I had acquired a good knowledge of the trade.

4. This city is the place of origin of the goods I wished to deal in, viz. cotton goods and machinery.

СТАТЬЯ́ ДЛЯ ЧТЕ́НІЯ

Ма́нчестерская экспо́ртная конто́ра.

Изъ жи́зни Ма́нчестерскаго экспорте́ра.

1. Приблизи́тельно два́дцать лѣ́тъ тому́ наза́дъ я рѣши́лъ отказа́ться отъ мое́й до́лжности гла́внаго управля́ющаго въ одно́мъ изъ Ма́нчестерскихъ экспо́ртныхъ домо́въ.

2. Я тогда́ заложи́лъ въ сою́зѣ съ мои́мъ ста́рымъ прія́телемъ со́бственное дѣ́ло.

3. Свои́мъ долголѣ́тнимъ пребыва́ніемъ въ Ма́нчестерѣ и заграни́цей я пріобрѣ́лъ большу́ю опытность въ торго́выхъ дѣла́хъ.

4. Этотъ го́родъ явля́ется (is) важне́йшимъ исто́чникомъ това́ровъ, кото́рыми я возна́мѣрился торгова́ть, а и́менно: хлопча́то-бума́жными издѣ́ліями и маши́нами.

5. The manufacture of cotton yarn and cotton textiles is carried on in various parts of Lancashire and forms, so to speak, the staple industry of this county.

5. Производством хлопчатобумажной пряжи и хлопчатобумажных материй занимаются во многих местностях Ланкашира, составляя, так сказать, господствующую промышленность сего графства.

6. Business is done also here on a large scale in machinery. My experience had naturally brought me into close touch with all the different persons interested in the production, sale and use of the articles in question.

6. Манчестер также делает значительный оборот продажей разных машин. Мой опытность в этих предметах естественно привела меня в соприкосновение с разными лицами, заинтересованными в производстве, продаже и употреблении предметов, о которых здесь идет речь.

7. I was consequently acquainted with all the principal firms in the market.

7. Я, следовательно, был знаком со всеми главными фирмами в рынке.

8. I was, moreover, fully equipped with the knowledge necessary to enable me to cater successfully for the requirements of oversea clients.

8. Къ тому я был вполне снабжен необходимым знанием, помогавшим мне успешно делать запасы для требований заморских покупателей.

9. My knowledge enabled me to purchase so economically from the manufacturer that I could reserve for myself adequate remuneration for my labour and outlay.

9. Мое знание способствовало мне покупать от фабрикантов товары так дешево, что я мог удержать за собою соразмерное вознаграждение за свой труд и расход.

10. Sufficient profit had to be made to cover myself for the risks run in dealing with distant places.

10. Деланіе достаточных барышей явилось необходимостью, дабы гарантировать себя от рисков, сопряженных с поддержаніем сношений с дальными странами.

11. Of course, when customers are established in distant places, this circumstance renders more difficult the settlement (clearing away) of any misunderstandings that may arise.

11. Какъ известно, при сношеніях съ покупателями отдаленных странъ часто приходится считаться съ серьезными затрудненіями въ уласиваніи возникших недоразумений.

12. Having thought all these matters out, and not lacking a little capital, I talked over the idea with my friend.

12. Передумавъ о всех этих обстоятельствах и имея въ своем распоряженіи немного капиталу, я переговорил объ этой мысли съ моим товарищем.

13. He had often told me he would like to join me in such an undertaking.

13. Онъ часто говаривалъ мне, что онъ былъ бы радъ пуститься со мною сообща въ подобное предпріятіе.

14. As he possessed ample means to meet all the liabilities we should need to contract, there was no trouble to be anticipated on the financial side.

14. Такъ какъ онъ владелъ обширными средствами къ полному оправданію нашихъ возможных обязательств, мы чувствовали себя вполне обезпеченными въ финансовом отношеніи.

15. We very soon came to an understanding and drew up a memorandum of all details of the proposed agreement between us.

15. Мы оба скоро пришли къ согласію и составили планъ всех подробностей предположеннаго договора между нами.

16. We then took this agreement over to our lawyers and had it put into legal shape as a Deed of Partnership.

16. Мы передали нашъ планъ нашему адвокату, который далъ ему законную форму въ видѣ Акта о Товариществѣ.

17. Our next move was to engage a small staff of assistants to attend to the preliminary details.

17. Велѣдъ затѣмъ мы наняли небольшой служебный персоналъ для выполненія предварительных работъ.

18. Their work mainly consisted in advising prospective customers that we had established ourselves in this city as a shipping firm.

18. Ихъ обязанности главнымъ образомъ заключались въ извѣщеніи нашихъ предполагаемых покупателей о б ъ учрежденіи нами н а ш е й "Манчестерской Экспортной Конторы."

19. I forgot to mention to you, however, that before engaging the staff, we found suitable premises.

19. Я забылъ напомнить Вамъ, однакожъ, что предварительно найма персонала мы отыскали себѣ подходящее помѣщеніе.

20. Well, to resume, in the circulars containing these particulars, we set forth all the advantages we hoped the customers would enjoy by dealing with us.

20. Ну, возвращаясь къ предыдущему,—въ циркулярахъ, содержавшихъ эти подробности, мы исчисляли всѣ выгоды, которыми, какъ мы надѣялись, наши покупатели пользовались бы при работѣ съ нами.

21. Owing to our capital and experience, I felt hopeful, nay—sure, that we should enjoy many special advantages.

21. Благодаря н а ш е м у капиталу и опытности, я былъ полонъ надежды и даже увѣренъ, что будемъ пользоваться многими спеціальными преимуществами.

22. Through their personal acquaintance with me many of the firms abroad were already informed of these advantages just referred to.

22. Чрезъ ихъ л и ч н о е знакомство со мною, многія изъ заграничных фирмъ уже были освѣдомлены объ этих преимуществахъ, о коихъ только что шла рѣчь.

23. It is evident that whilst I was a traveller and subsequently manager for my old firm, I had endless opportunities of acquiring useful knowledge.

23. Какъ видно, мой разъѣзды отъ имени моей старой фирмы и затѣмъ моё управленіе ей дѣлами мнѣ дали много случаевъ къ обогащенію себя полезными свѣдѣніями.

24. Along with the letters announcing the above named facts our employees sent a variety of nice patterns, to induce the clients to give us trial orders.

24. Вмѣстѣ съ письмами, объявлявшими о вышеупомянутых фактах, наши служащіе высылали множество красивых образцовъ, дабы пріохотить клиентовъ къ удостоенію насъ пробными заказами.

25. The terms of payment were stated in these letters, and our assistants took good care to enclose price-lists of the patterns submitted.

25. Въ тѣхъ письмахъ были вложены прейсъ-куранты, относившіеся къ высланнымъ образцамъ, съ указаніемъ условій (платежа).

26. We also showed discounts, if any, to enable the customers to make up their minds as to whether it suited them to favour us with any orders.

26. Гдѣ возможно, мы указывали наши размѣры скидки, давая тѣмъ нашимъ покупателямъ возможность рѣшить на мѣстѣ, насколько для нихъ выгодно удостоить насъ заказомъ.

27. All other details were given in the letters for this same purpose.

28. After some little time we received replies, which we opened with great interest, hoping they brought orders.

29. In our price-lists we described all articles by their foreign names, so that the purchasers might know exactly what they were doing.

30. We often arranged for draft terms with our customers, and the latter paid our draft by a bill on London.

31. The proceeds, i.e. the bill just mentioned, in payment of our draft, was generally negotiated at the best rate of discount ruling in this market on day of arrival.

32. We often found it advantageous to sell foreign produce here, in payment of account for goods bought from us by foreign customer.

33. In this way we combined both import and export.

34. The whole of our staff, that is, clerks, warehousemen, pattern-men, buyers, packers, and makers-up were very busy attending to the despatch of patterns, circulars, offers, catalogues, etc.

35. They also looked after the forwarding of the goods, such as Greys, Whites, Prints, Fancies, Dyed Materials, etc.

36. The pieces were generally made up according to the taste of the market for which they were intended.

37. I should explain that making-up means folding, stitching, ticketing, and, sometimes, papering the pieces of woven goods.

27. На́ша корреспонде́нція содержа́ла вся́кія другія́ подро́бности для той же це́ли.

28. Спустя́ не́которое вре́мя мы ста́ли получа́ть отве́ты, кото́рые мы открыва́ли съ больши́мъ любопы́ствомъ, разсчи́тывая что они́ намъ принесли́ зака́зы.

29. Въ на́шихъ прейскура́нтахъ мы опи́сывали всѣ артику́лы подъ ихъ иностра́нными назва́ніями, дѣлая всё я́сно и поня́тно для на́шихъ кліе́нтовъ.

30. Мы ча́сто услов́ливались съ на́шими покупа́телями о выставле́ніи на нихъ перево́да, кото́рый они́ должне́нствовали опла́чивать ве́кселемъ на Ло́ндонъ.

31. Подо́бный ве́ксель въ упла́ту на́шего перево́да обыкнове́нно учи́тывался на́ми неме́дленно по получе́ніи по са́мому вы́годному уче́тному ку́рсу того́ дня.

32. Мы о́чень ча́сто находи́ли для себя́ вы́годнымъ продава́ть здѣсь иностра́нные проду́кты въ зачёт причита́вшихся намъ съ иностра́нныхъ покупа́телей суммъ за отпу́щенные имъ това́ры

33. Таки́мъ путе́мъ мы сочета́ли ввозну́ю торго́влю съ вы́возной.

34. Весь нашъ персона́лъ то есть: писцы́, прика́щики, завѣ́дывающіе образца́ми, заку́пщики, пако́вщики и загото́вщики бы́ли о́чень за́няты рабо́тами по пересма́тривѣ образцо́въ, цирку́ляровъ, предложе́ній, катало́говъ и проч.

35. Они́ та́кже наблюда́ли за экспеди́ціей това́ровъ, какъ-то: суро́выхъ и отбѣленныхъ мате́рій, си́тцевъ, фантазійныхъ и окра́шенныхъ тка́ней и проч.

36. Кусо́къ вообще́ отдѣлывались въ соотвѣтственности съ вку́сомъ того́ ры́нка, для кото́раго они́ предназнача́лись.

37. Счита́ю нелишнимъ поясни́ть, что подъ выраже́ніемъ „заготовле́нія" разумѣется скла́дываніе, состега́ніе, снабже́ніе этике́тами, а иногда́ та́кже и запе́ртываніе въ бума́гу куско́въ тка́нныхъ мате́рій.

A. C.

ITALIAN.—IV

The Verb.—The following table shows the conjugation of the verbs **avere** and **essere** mentioned in the First Lesson :—

Infinitive Mood :	avere, *to have.*	essere, *to be.*
Pres. Participle :	avendo, *having.*	essendo, *being*
Past Participle :	avuto, *had.*	stato, *been.*

INDICATIVE MOOD

Sing.	*Plur.*	*Sing.*	*Plur.*
Ho	abbiamo	Sono	siamo
hai	avete	sei	siete
ha	hanno	è	sono

As each person is clearly indicated by the ending of the verb, a separate pronoun is generally unnecessary. If given in full, the present tense would be :—

Sing.	*Plur.*
Io ho, *I have.*	noi abbiamo, *we have.*
tu hai, *thou hast.*	voi avete, *you have.*
egli (esso) ha, *he, it, has.*	églino (essi) hanno, *they have* (m.).
ella (essa) ha, *she, it, has.*	élleno (esse) hanno, *they have* (f.).
Io sono, *I am.*	noi siamo, *we are.*
tu sei, *thou art.*	voi siete, *you are.*
egli (esso) è, *he, it, is.*	églino (essi) sono, *they are* (m.).
ella (essa) è, *she, it, is.*	élleno (esse) sono, *they are* (f.).

Egli, ella, églino, élleno refer only to persons.

Esso, essa, essi, esse refer to persons, animals, and things.

Eglino, élleno are now almost supplanted by **essi, esse.**

Examples

Avere molto tempo,	*To have much time.*
Essendo un momento favorévole per . . .	*Being a favourable moment to* (for) . . .
Avendo avuto le etichette per le pezze,	*Having had the tickets for the pieces* (of cloth etc.).
Essendo stati stanchi,	*Having been tired* (pl., masc.).
Non abbiamo molto tempo (**non** always precedes the verb),	*We have not much time.*
Io sono certo che il mío rappresentante nulla ha tralasciato per réndere contenti (soddisfatti) i compratori,	*I am sure that my representative has neglected nothing in order to satisfy* (render content) *the buyers.*
Ci hanno rimesso il loro preventivo,	*They have forwarded to us their estimate* (lit. : to us they have remitted the their estimate.)
Siamo rimasti tutta la mattina fino a mezzodì in ufficio e quindi siamo andati in campagna,	*We remained* (have remained) *all the morning until midday in the office* (*the* understood), *and then we went* (are gone) *into the country.*

Avete mandato il campione ai compratori ?	*Have you sent the pattern to the buyers ?*
No, non ho mandato niente,	*No, I have not sent anything* (lit. : no, I have not sent nothing).
Hanno i ragionieri verificati i conti ?	*Have the accountants checked the accounts ?*

(A transitive past participle sometimes agrees with a following direct object — *here* **conti**, m. pl. accusative. This agreement, however, is optional.)

When unaccented "**i**" merely serves to soften a preceding **c** or **g** before the vowels **a**, **o**, or **u**, as in the words **faccia** (f.), *face*, **foggia** (f.), *fashion, manner, shape;* it may be omitted as superfluous in the plural, which is then **facce**, **fogge.**

After a preposition the infinitive is used in Italian, not the present participle as in English. This use of the infinitive is made clear in the following sentences.

Examples

Prima **di entrare** ha bussato alla porta,	*Before entering, he has knocked at the door.*
Dopo (or dopo di) **aver** parlato, si è seduto,	*After speaking* (after having spoken) *he has sat down.*
Nel partire, si dice addío agli amici,	*On departing, one says goodbye to one's friends* (lit. : in the to depart it says itself goodbye to the friends).
Col lavorare (or simply lavorando) guadagniamo il pane quotidiano,	*By* (with the) *working we earn our daily bread.*

VOCABULARY

cioè, *that is*, or *i.e.*
ci duóle, *we are sorry, it pains us.*
l'avvocato (m.), *the lawyer.*
soddisfatto (di), *satisfied* (with).
il creditore, *the creditor.*
bisogna (bisognare), *it is necessary.*
le, *to her.*
dirle, *to say to her.*
transígere, *to transact.*
soffrire, *to suffer.*
domandare, *to ask, demand.*
riméttere, *to remit.*
il chèque, *the cheque* (pronounced *shek*).
cento, *a hundred.*
la (lira) sterlina, *the pound sterling.*
il cassiere, *the cashier.*
vogliamo (volere), *we want.*
la chiave, *the key.*
lo scrittóio, *the desk.*
finire, *to finish.*
la pellíccia, *the fur, fur coat, pelisse.*
risólvere, *to resolve, make up one's mind to do something.*
mi è riescito, *I have succeeded* (lit., it is succeeded to me).
incórrere, *to incur.*
il danno, *the damage, loss.*
per cento, *per cent.*
caro, *dear.*
ordinario, *ordinary, usual.*
vogliate, *please* (lit., [you] wish !).
sapere, *to know.*
súbito, *immediately, at once.*
contare, *to count.*
il pagamento, *the payment.*
trovare a, *to be able to* (lit., to find to).
esitare, *to sell, dispose of.*
il vino, *the wine.*
passare, *to pass, place.*
il crédito, *the credit.*
la risposta, *the reply, answer*
quattro, *four.*
sédici, *sixteen.*
scorso, *ultimo.*
la pelliccería, *the furs, furriery.*
quíndici, *fifteen.*
per, *by.*
la posta, *the post.*
l'importo (m.), *the sum, amount.*
defalcare, *to deduct.*
lo sconto, *the discount.*
giústa, a seconda di, *according to.*
la cassa, *the cash.*
a pronta cassa, *for prompt cash.*
pérdere, *to lose.*
un mío amico, *a friend of mine* (lit., a my friend).
cotesto, *that* (near person addressed).
cotesta (= cotesta cittá), *your city* (where person addressed resides).
rispettábile, *respectable, esteemed.*
il desidério, *the desire, wish, request.*
manifestare, *to show, express, manifest.*
gradito, *esteemed.*
diretto, *directed, sent.*
la seta, *the silk.*
il dispiacere, *the displeasure, regret.*
dovere, *to have to, must.*
diéci, *ten.*
l'osservazione (f.), *the remark.*
so (sapere), *I know.*
che, *what.*
giúngere, *to arrive*, giunto (past part.), *arrived, come.*
atténdere oltre, *to wait further* or *longer.*
saldare, *to settle, balance.*
la compra, *the purchase.*
il cotone, *the cotton.*
soltanto, *only, but.*
seguente (m. or f. sing.), *following.*
la condizione, *the condition.*
detto, *said.*
suddetto, *above-named.*
Páolo, *Paul.*
Signore (Sig.), *Mr.*
spero, *I hope.*
riverito, *respected, esteemed.*
il comando, *the order.*
síano, *be, are* (pr. subj. of essere, used after expression of regret).
i miéi, *my* (m. pl.).
di, che, *than.*
far (= fare) sapere, *to let know.*
se, *whether.*
posso, *I may, I can.*
trasmesso, *transmitted.*
sommesso, *submitted.*
l' offerta (f.), *the offer.*
il suo, *his.*
dite, *tell, say* (imper. 2 pl.).
sapete, *you know.*
la cambiale, *the bill of exchange.*
letto, *read* (past part.).
preghiamo, *we request.*
avrete (avere), *you will have.*
fare, *to do, make.*
riferire, *to relate, refer.*
témono (temere), *they fear.*
abbiate (avere) *you* (may) *have* (pr. subj.).

Exercise 7

Translate into English :—

1. Abbiamo parlato all' avvocate e molto ci ha detto (riferito) su questo affare. 2. Avendo soddisfatto tutti i loro creditori, nulla témono. 3. Bisogna scrívere alla casa e dirle che non possiamo transígere l'affare senza soffrire una pérdita considerévole. 4. Gli ho domandato di riméttermi un chèque (pronounced *shek*, as in French) per cento sterline, ma egli ha rifiutato. 5. Il nostro ragioniere non ha ancora verificati i conti, dice il cassiere. 6. Vogliamo la chiave che è nello scrittóio del cassiere. 7. I nostri commessi hanno finito tutto il loro lavoro per oggi. 8. Queste pellicce sono (or questa pelliccería è) pel negoziante e questo danaro è per i viaggiatori. 9. Stamattina son (= sono) giunte (or venute per la posta) quíndici léttere. 10. Ha spedito per posta l'importo della fattura defalcando lo sconto giústa i nostri órdini. 11. Abbiamo venduto la merce a pronta cassa e non possiamo atténdere oltre senza incórrere danni. 12. Un mío buon' (=buono, before a vowel) amico di cotesta (cittá) (or di costi) mi ha favorito il nome della vostra rispettábile ditta. 13. A seconda del desidério manifestátoci colla gradita vostro (léttera

understood), abbiamo diretto ai vostri rappresentanti diversi campioni di velluti e seta. 14. Ci duóle (abbiamo il dispiacere) di dovervi informare che i prezzi sono 10% (diéci per cento) più cari dell' ordinario. 15. Vogliate farmi sapere súbito quando possiamo contare sul pagamento. 16. Mi è riescito esitare tutto il vostro vino e ne ho passato l'importo a vostro crédito. 17. Essendo rimaste (f. pl.) senza risposta le míe léttere del quattro corrente e sédici scorso, vi sollécito di saldare súbito il mío conto. 18. (Eglino) sono disposti ad affidarvi le loro compre di cotone e pelliccerie, ma soltanto alle condizioni seguenti. 19. Il detto (suddetto) mío agente a Torino, Sig. (= Signore) Páolo Simonetti vi ha rimesso il mío preventivo e spero che ci avrete onorati dei vostri riveriti comandi. 20. Siam (= siamo) certi che i nostri rappresentanti nulla han (= hanno) tralasciato per réndervi contenti e perciò ci rincresce molto che abbiate passato i vostri órdini ad altri.

Exercise 8

Translate into Italian :—

1. I have spoken to the lawyer, but he has told me little about (of) this matter. 2. The clerks of (the) my friend (my friend's clerks) have written all their letters for to-day. 3. They have forwarded by post the amounts of the invoices, less the discount of (the) ten per cent., according to the orders of our customers. 4. A good friend of ours (translate, an our good friend) in your town has favoured us with the name of your esteemed (say, respectable) firm. 5. I am sorry to have to (di) tell you (dovervi dire) that my prices are now ten per cent. dearer than (di) usual ; please, therefore, let me know by post whether I may count upon your orders. 6. We have learned (known) that our agent in Milan has submitted to you our estimate. 7. In accordance with our wish, our traveller has submitted various patterns to the said firm in your city. 8. You must (it is necessary) write at once and refuse his offer. 9. Tell (say to) the firm that I cannot transact the business. 10. You know that we have asked him to remit us a bill for (of) a hundred pounds sterling. 11. When have you checked his invoices, i.e. the invoices which he has made. 12. I have received their circular, and I have read all their remarks with pleasure. 13. As my letters of the sixteenth instant and fourth ultimo have (are) remained unanswered (without answer) (translate, essendo rimaste, etc.), I do not know what to do (fare). 14. I have forwarded (directed) the patterns according to the wish expressed in your esteemed favour of the fourth instant. 15. Please let us know when you (have) remitted the money. 16. We request you to square up (balance) our account. 17. I am not afraid (translate, I have not fear) of not receiving (to receive) the orders. 18. Our accountants say that they have not yet had the time to (of to) check our books. 19. Where are the keys of the cashiers' desks ? 20. I am sorry that our orders have (are, pr. subj.) gone to others, but your prices are too dear.

A. C.

SPANISH.—IV

The Verb.—We will now compare the present tense, indicative mood, of the three conjugations :—

Present Tense—Indicative Mood

FIRST (OR **A**) CONJUGATION

	Sing.	*Plur.*
1.	cò**mpro**, *I buy.*	compr**àmos**, *we buy.*
2.	cò**mpras**, *thou buyest* (familiar).	compr**áis**, *you buy* (familiar).
3.	cò**mpra**, *he buys.*	cò**mpran**, *they buy.*
V.	cò**mpra**, *you buy* (referring to one person).	Vs. cò**mpran**, *you buy* (addressing more than one person).

The student is reminded that only the third person of the verb preceded by V. or Vs. is used in business and ordinary conversation by foreigners, the second person, as for instance : **còmpras**, and **compráis**, being reserved by Spaniards for family intercourse or conversation with very intimate acquaintances.

SECOND (OR **E**) CONJUGATION

	Sing.	*Plur.*
1.	vèn**do**, *I sell.*	vend**èmos**, *we sell.*
2.	vènd**es**, *thou sellest* (fam.).	vend**éis**, *you sell* (fam.).
3.	vènd**e**, *he sells.*	vèn**den**, *they sell.*
V.	vènd**e**, *you sell.*	Vs. vèn**den**, *you sell.*

THIRD (OR **I**) CONJUGATION

	Sing.	*Plur.*
1.	sùp**lo**, *I supply.*	supl**imos**, *we supply.*
2.	sùp**les**, *thou suppliest* (fam.).	supl**ís**, *you supply* (fam.).
3.	sùp**le**, *he supplies.*	sùpl**en**, *they supply.*
V.	sùp**le**, *you supply.*	Vs. sùpl**en**, *you supply.*

Consequently the endings of the Present Indicative for regular verbs of the three conjugations will be :—

	yo	tú	él (èlla, V.)	nosòtros (-as)	vosòtros (-as)	èllos (èllas Vs.)
A or 1st Conjugation	-o	-as	-a	-àmos	-áis	-an
E or 2nd Conjugation	-o	-es	-e	-èmos	-éis	-en
I or 3rd Conjugation	-o	-es	-e	-ìmos	-ís	-en

Past Imperfect Tense—Indicative Mood

FIRST (OR **A**) CONJUGATION

	Sing.	*Plur.*
1.	compr**àba**, *I was buying*, or *I used to buy.*	compr**ábamos**, *we were buying.*
2.	compr**àbas**, *thou wast buying*, etc. (fam.).	compr**àbais**, *you were buying* (fam.).
3.	compr**àba**, *he was buying*, etc.	compr**àban**, *they were buying.*
V.	compr**àba**, *you were buying*, etc.	Vs. compr**àban**, *you were buying.*

SECOND (OR **E**) CONJUGATION

Sing.	*Plur.*
1. vend**ía**, *I was selling*, or *I used to sell.*	vend**íamos**, *we were selling*, etc.
2. vend**ías**, *thou wast selling*, etc. (fam.).	vend**íais**, *you were selling*, etc. (fam.).
3. vend**ía**, *he was selling*, etc.	vend**ían**, *they were selling*, etc.
V. vend**ía**, *you were selling*, etc.	Vs. vend**ían**, *you were selling*, etc.

THIRD (OR **I**) CONJUGATION

Sing.	*Plur.*
1. supl**ía**, *I was supplying*, etc.	supl**íamos**, *we were supplying*, etc.
2. supl**ías**, *thou wast supplying*, etc. (fam.).	supl**íais**, *you were supplying*, etc. (fam.).
3. supl**ía**, *he was supplying*, etc.	supl**ían**, *they were supplying*, etc.
V. supl**ía**, *you were supplying*, etc.	Vs. supl**ían**, *you were supplying*, etc.

There is another past tense, called the Past Definite, which is only used to indicate that the action expressed took place and was finally concluded at some particular moment, whilst the Imperfect, as shown above, signifies that the action is looked upon as continuous or recurrent. The endings of the Past Definite will be given in the next lesson.

It will be seen that the endings of the Imperfect Indicative for regular verbs of the three conjugations are given in the table below.

As already explained on pages 351, 417, the Future and Conditional of any regular verb is formed by adding to the full Infinitive the following terminations :—

Future :— **-é, -ás, -á, -èmos, -éis, -án,**

Conditional :— **-ía, -ías, -ía, -íamos, -íais, -ían,**

Irregular verbs also take these endings in the Future and Conditional Indicative, as their irregularity is always confined to the Infinitive portion of the word.

Examples

Compraré el lòte á cuàtro penìques el mètro.	*I shall buy the lot at 4d. per metre.*
Venderíamos ùna pequèña cantidàd.	*We should sell a small quantity.*
Compràban sus mercancías en càsa de Vs.	*They were buying (used to buy) their goods from your firm.*
Sùplo èste artículo á mùchas càsas.	*I supply this article to many firms.*
Comprarèmos en Amérika y venderèmos en Inglatèrra.	*We shall buy in America and we shall sell in England.*
¿ Vendían Vs. más géneros que nosòtros ?	*Were you selling (used you to sell) more goods than we ?*
V. vende sus artículos á prècios mùy àltos.	*You sell your goods at very high prices.*
Yo recibiría un suèldo bastànte bàjo.	*I should receive a rather low salary* (literally, *a salary sufficiently low*).
Incluìmos (from **incluir**) còpia de nuèstra última càrta.	*We enclose copy of our last letter.*
Pondrán (from **poner**, *to put*) algùnos telegràmas á là càsa de V.	*They will send some telegrams to your firm.*

	yo	tú	él (èlla, V.)	nosòtros (-as)	vosòtros (-as)	èllos (èllas, Vs.)
A or 1st Conjugation	-àba	-àbas	-àba	-ábamos	-àbais	-àban
E or 2nd Conjugation	-ía	-ías	-ía	-íamos	-íais	-ían
I or 3rd Conjugation	-ía	-ías	-ía	-íamos	-íais	-ían

Future Tense—Indicative Mood

	yo	tú	él (èlla, V.)	nosòtros (-as)	vosòtros (-as)	èllos (èllas, Vs.)
1. *I shall buy*, etc., **comprar** 2. *I shall sell*, etc., **vender** 3. *I shall supply*, etc., **suplir**	-é	-ás	-á	-èmos	-éis	-án

Conditional Form—Indicative Mood

	yo	tú	él (èlla, V.)	nosòtros (-as)	vosòtros (-as)	èllos (èllas, Vs.)
1. *I should buy*, etc., **comprar** 2. *I should sell*, etc., **vender** 3. *I should supply*, etc., **suplir**	-ía	-ías	-ía	-íamos	-íais	-ían

Trasmitiríamos (from **trasmitir**) èsta noticia á nuèstro amìgo.	*We should forward this news to our friend.*
Sentiríamos mùcho no recibìr los géneros.	*We should be very sorry not to receive the goods.*
Deseábamos recibìr la factùra del envío.	*We were desirous of receiving (we wished to receive) the invoice of the shipment.*
Enviaré á V. ùna remèsa en el mes que viène.	*I shall send you a remittance next month (in the month which comes).*
Recibíamos muy frecuentemènte artículos de España.	*We used to receive very frequently goods from Spain.*
Hablàban con nosòtros sòbre diferèntes asùntos.	*They were speaking with us on different matters.*
Comprábamos tòdo en càsa de él, pèro en lo sucesìvo comprarèmos nuèstros géneros en el almacén de Vs.	*We used to buy everything from his firm, but in the future we shall buy our goods in your warehouse.*
El pasìvo de la càsa es enòrme.	*The liabilities of the firm are enormous.*

VOCABULARY

lo pasàdo, *the past.*
pòco, (pl.) pòcos, *little, few.*
ahòra, *now.*
el pasìvo, *the liabilities.*
la declaración, *the declaration.*
el dividèndo, *the dividend.*
vàrios (pl.), *sundry, different.*
Alemània (f.), *Germany.*
la Guèrra, *the War.*
nàda, *nothing.*
último, (f.) última, *last.*
càsi, *almost, nearly.*
vivìr, *to live.*
pequèño, (f.) pequèña, *little, small.*
su, (pl.) sus, *his, her, your, their.*
àlto, *high.*
àntes, *before, formerly.*
Frància, *France.*
Rùsia, *Russia.*
tan, *so.*
por ciento, *per cent.*
mùcho, (f.) mùcha, *much.*
mùchos, (f.) mùchas, *many.*
algùnos (pl.), *some, any.*
deseàr, *to desire, to wish.*
enviàr, *to send.*
cìnco, *five.*
el duplicàdo, *the duplicate.*
cièn, abbr. of ciènto, *a hundred.*
el actìvo, *the assets.*
la remèsa, *the remittance.*
diferènte, (pl.) diferèntes, *different.*
el àño, *the year.*
permitìr, *to permit, to allow.*
gràn de, *great, large, big.*
sé (from **sabèr**), *I know.*
pondría (from **ponèr**), *I should put, send* (a telegram).
podìdo (past part. of **podèr**), been able.
puède (from **podèr**), *he can.*
dos, *two.*
convendría (from **convenìr**), *I should suit.*
extranjèro, *foreign.*
càda, *each.*
subìr, *to rise.*
salìr, *to leave.*
le pagarèmos á V., *we shall pay you.*
sólo, solamènte, *only* (adv.).
enòrme, *enormous.*

Exercise 5

Translate into English :—

1. ¿ Pediría V. los nuèvos dibùjos ? 2. Sí, señòr, yo pediría tòdos los nuèvos dibùjos. 3. ¿ Vendían Vs. mùchos géneros á èsta en lo pasàdo ? 4. No, vendíamos muy pòcos artículos á èlla. 5. Còmpro pòcos artículos en èstà càsa ahòra, pèro àntes compràba bastànte. 6. Sentirèmos mùcho no ver á V. en nuèstra càsa. 7. Deseará recibìr duplicàdos de las muèstras. 8. Desèo escribìr hoy ùna càrta á mi eliènte. 9. Enviábamos mùchos bùltos tòdos los años á èllos. 10. Vendèmos cièn càjas por mes al Sr. (= Señòr) González. 11. El actìvo no permitirá la declaración de un dividèndo tan grànde. 12. Yo compraría tòdo en càsa de Vs., pèro no sé si sus prècios me convendrían. 13. Venderé una pequèña cantidàd de mercancías. 14. Suplìmos èste artículo á vàrios clièntes. 15. ¿ Compràba V. mùcho en Alemània àntes de la Guèrra ? 16. Vs. no venderían nàda á prècios tan àltos.

Exercise 6

Translate into Spanish :—

1. The customers would order the new designs. 2. Would you order all the goods ? 3. Formerly we sold (used to sell—Imperfect) many goods to this firm. 4. If you (pl.) can supply me with (supply to me) these goods, I shall buy large quantities. 5. We should be very sorry not to see you (pl.) to-morrow in our office. 6. They wished to receive duplicates of all the patterns. 7. They write many foreign letters each day. 8. I shall send you the ten packages this week without fail. 9. They bought this lot of goods at 4d. per metre. 10. We cannot sell this article in small quantities. 11. They make us (tr. to us they make) a remittance every month. 12. He received such a low salary (tr. a salary so low) that he could scarcely (tr. almost could not) live. 13. If the prices rise, we shall send (Fut. of *poner*) a telegram to all our customers. 14. I should have sent (put) a telegram to my customer before, if I had been able. 15. He used to send me the patterns before the goods. 16. They used to buy a great deal (much) in Germany before the War, but now they buy everything (all) in France.

Key to Exercise 1

1. Has the director arrived ? 2. He has not arrived. 3. Have you received the letter ? 4. I (have) received the letter to-day and some books yesterday. 5. Have we accepted the bills (of exchange) ? 6. We have not accepted them. 7. Have the merchants bought the goods ? 8. A director has bought them. 9. Have they finished the goods (cloths) ? 10. They have finished them. 11. Are the buyer and my partner purchasing the cloths ? 12. They are buying them. 13. Have you paid the advance ? 14. We have paid it. 15. Have we sold the prints (printed calicoes) ? 16. We have not sold them, but we have sold some machines. 17. Have you entered (in) the warehouse ? 18. No, I have not entered (in) the warehouse to-day. 19. Have you spoken with my brother ? 20. Going out of the warehouse, we have spoken (spoke) with him.

1. Hèmos escrìto en los lìbros. 2. Han aprestàdo las tèlas ayèr. 3. ¿ Ha correspondìdo V. ùna vez con los clièntes ? 4. Hèmos escrìto dos (vèces) o tres vèces á los clièntes. 5. ¿ Ha escrìto V. al sòcio del negociànte ? 6. No, Señòr, pèro he escrìto al compradòr del negociànte. 7. ¿ Estàn bien aprestàdas las tèlas blàncas ? 8. Las tèlas blàncas están muy bien aprestàdas. 9. Dividièndo el dinèro èntre los sòcios. 10. Los abogàdos han estudiàdo las lèyes de Inglatèrra. 11. Los vapòres han llegàdo ayèr. 12. Ùnos géneros han llegàdo de Espàña. 13. Compràndo ùnas existències en el almacén. 14. Vendièndo los géneros (las tèlas) al prècio mencionàdo. 15. ¿ Hèmos hablàdo con él hoy ? 16. Sí, Señòr, pèro no ha contestàdo. 17. Salièndo del almacén hoy ó mañàna. 18. Hèmos temìdo èsto. 19. ¿ Han compràdo la tèla ? 20. Han comprado el pàño y vendìdo las máquinas.

A. C.

Continued from page 424.

GEOGRAPHY:

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AFRICA.—IV

PERHAPS the simplest way of dealing with the African products will be to take each by itself, and to point out the areas of which it is a native. Agriculture is the most ancient of the continent's sources of wealth, the agricultural history of its northern half counting already some thousands of years when Egypt was the granary of Rome. We may take the agricultural range of products first, therefore, beginning with wheat.

Corn in Egypt

Egypt and other parts of North Africa still grow excellent wheat, and the quantity, indeed, is greater than it was in the days of the Romans, owing to the greater areas of soil which now benefit from the extended area of irrigation. The other territories of the continent which are eminently suitable to wheat are those of British South Africa.

Here wheat-growing is largely on the increase, the production of the States of the Union having more than doubled itself between the years 1904 and 1911. Wheat will flourish anywhere on the great plateau of the south, provided that sufficient rainfall is obtained, but the finest of the wheat-growing regions here are situated in the Orange Free State and in Basutoland.

To deal with the other cereals, some of the best barley in the world is grown in North Africa, and the oases also produce this in considerable quantities. It is also cultivated in South Africa. Maize, originally introduced from South America, is cultivated in both the north and south of the continent.

Millet and sorghum, sometimes called durrha, flourish in North Africa. Rice is grown principally in the valley of the Upper Niger and in Madagascar, while manioc, or arrowroot, introduced from Brazil, is grown in the forest regions as well as the Sudan.

Sugar-cane is grown extensively in the irrigated lands of Egypt, and it is also produced in great abundance in the valleys of Natal and Rhodesia, and in the coastal plain which spreads to the north of the Limpopo River.

Dates and olives belong especially to the north, the former being of particular importance to Tunis, Morocco, and Algeria. It is in these three countries that the olive too is most abundant, some of the finest olive oil in the world being exported from the African Mediterranean littoral. Lentils and almonds are typical, too, of North Africa, as is the fig; though it must be said that the cultivation of this last fruit is widespread in the continent.

Bananas, plantains, and pineapples are cultivated with great success in the forest zone of the west coast.

African Palm Oil

A product that is essentially associated in the public mind with Africa is palm oil. The oil-palm from which this is derived is met with in the west coast and the Congo Basin. Here, it is found in quantities which enable a very important export trade to be carried on. Other products that are typically African are acacia gum and copal gum. The former is a special product of the Sahara, more especially in the southern districts of that arid area: the latter is met with in East Africa and Madagascar.

Rubber—so far as the mainland is concerned—is practically confined to the low lying forest belt of the west coast, the Congo and Mozambique. Its area, however, is a large one, and the exports of this product are very important. Rubber is also met with in large quantities in the island of Madagascar, and the export trade in this is of great importance to the island.

Ground nuts are found in the west, the east and the southern-central portions of the continent, and form an important article of commerce. Esparto grass is restricted in its area to the north coast, chiefly

to that of Algiers. The Raffia palm, which produces the piassava fibre, is chiefly met with in the western forest zone.

Neither cotton nor coffee has a large range of growth, the former being chiefly cultivated in Egypt, Nyasaland, and Zambesia; and the latter in Liberia, Nyasaland, and the Island of Saõ Thomé. Tea planting has not yet attained to any importance in Africa, very little being grown outside Natal and the Shiré Highlands.

Tobacco, on the other hand, is very widely distributed. Some of the very finest of the cigarette tobaccos are grown in Tunis. Others of less excellent quality are cultivated in many parts of the Sudan, and almost throughout the forest belt of the west coast. The industry has now been strongly taken

Drawn by Sir H. H. Johnston.

A RAFFIA PALM IN FLOWER.

This palm produces the fibre largely employed for making brooms and brushes, and the "bast" used by gardeners.

up by Rhodesia and Nyasaland, both of which territories now export considerable quantities of tobacco.

Cocoa is obtained from the Congo, Nigeria, the Ivory Coast, and some neighbouring territories, and many fine cabinet woods, as well as the vegetable-ivory, are exploited in the western forest belt.

The cultivation of fruits is naturally confined to the temperate regions of the north and the south of the continent. In both of these widely separated areas they flourish with quite unusual success. Algeria and Tunis have now devoted themselves with enthusiasm to those branches of fruticul-

Photo: by permission of the High Commissioner for South Africa.

BANANA TREES

bear fruit profusely in South Central Africa and other moist regions of the continent.

ture and market-gardening to which the climate and soil of these countries lend themselves so admirably. They already export large quantities of early fruit and vegetables to Europe, among these being strawberries, cherries, peas, potatoes, almonds, figs, and dates.

The orange is another notable fruit of these latter regions. This product is of no little commercial importance, the "blood" orange of Tunis being one of the most famous of its kind in the world.

These Mediterranean regions of Africa are famous for the quality of the grapes they produce. An important commerce is carried on in Algerian wine. This is a species of claret, and is frequently shipped to France to be blended with the wines of Bordeaux. Plantains and bananas are cultivated extensively in most of the moist regions, but form an important item of native diet in the forest zone.

The principal fruits cultivated in South

Africa are grapes, pears, peaches, nectarines, apricots, plums and melons. Although this field of cultivation is situated at a much greater distance from Europe than is that of the north of Africa it has this compensation, that its fruits, being grown south of the line, are available during the northern winter, and are thus in season at a period when none of the European fruits are to be obtained. These South African fruits are brought to London in cold storage.

we may take a rapid survey of the general distribution of minerals throughout the continent.

Copper is met with in Tunis, Morocco, Algeria, Darfur, Northern Nigeria, Northern Angola, South Congoland—where it is especially plentiful—Rhodesia, The Cameroons, and British South Africa.

Lead is found in the mountains of north-east Tunis, in the heights of Eastern Algeria, and in Morocco. Iron and zinc are found

Photo: The late Rev. George Grenfell.

THE OIL PALM.

which flourishes in the Congo basin and on the West Coast, produces the oil which forms one of Africa's most valuable exports, and makes the best candles, the best soap and many other of the things required by civilised man.

The mineral products of Africa are associated in the public mind chiefly with the famous gold and diamond fields of the south. The mineral wealth of Africa, however, is by no means confined to these regions. How wide is the range of auriferous territories alone will be gathered from the fact that gold is found in Upper Senegal, Liberia, Senegambia, Ashanti, the Belgian Congo, Uganda, East Africa, Abyssinia, Galaland, Katanga, and Zambesia.

Before dealing with the important gold and diamond fields of British South Africa, in these same districts, together with a small amount of silver. Africa is poorly supplied with this last mineral, so far as is at present known. The principal region where tin is found is Northern Nigeria. Emeralds are met with in the mountains on the coast of the Red Sea.

The mining era of South Africa dates from the year 1871, when diamonds were found at Kimberley.

The diamond fields of British South Africa are situated in West Griqualand, the Orange Free State, and in the Transvaal.

The most famous mines of the Orange Free State are those of Jagersfontein and Koffyfontein, whiie the Transvaal is notable for the Premier mine, the largest in the world. Some diamond districts are now being opened up in Rhodesia, and it is quite possible that extensive developments may occur in these territories.

The diamond industry is not confined to British South Africa, although this region contains by far the most important fields. These precious stones are now discovered in considerable quantities at Angra Pequena in the South-West African Protectorate, and some important discoveries of the stones have now occurred in Western Liberia.

The principal goldfields of South Africa are those of the famous Witwatersrand, popularly known as "The Rand." This is the most lucrative gold-producing centre in the world. Other fields are met with to the west of Johannesburg, and in Swaziland, Natal, and Matabeleland.

Coal is found in the Transvaal, where over five million tons are now annually produced. The most important coal-producing centres here are at Brakpan, Middelburg, and Vereeniging. Natal, too, has its notable collieries, producing over two and a half million tons annually.

The animal products of Africa, although from the commercial point of view they can scarcely vie in importance with the vegetable and mineral products, are sufficiently varied.

Cattle Rearing

Cattle are more widely distributed about the continent than might be imagined would be the case. A certain number are bred in the south of the Sahara, and in the interior of Nigeria. They exist, too, in Kordofan, Portuguese West Africa, and British East Africa. But—as is the case with so many other products of the continent—it is in South Africa that the cattle-breeding industry has attained to its greatest development. The southern plateau is well adapted to the breeding of cattle almost throughout its length and breadth. There are many districts, nevertheless, more especially in the northern territories of South Africa, where these animals are wont to suffer from disease. The rinderpest is the most dreaded of all these ailments. This scourge, which would seem to have its true home in Equatorial Africa, breaks out in the south from time to time, and its appearance is the signal for a disastrous mortality among the herds. Notwithstanding such drawbacks as these the industry flourishes.

Sheep are bred all along the Mediterranean coast of Africa, from Agadir in the west to Alexandria in the east. They are well established in the south of the French Sahara, and have been introduced into Kordofan and Uganda. The country best adapted to these animals in South Africa is the Karroo and the High Veld of the Orange Free State and the Transvaal. In these districts are flocks of considerable importance.

Horses are chiefly bred in Morocco, Algeria, Tunis, Abyssinia, and British South Africa. In this latter region horses are no more free from disease than are the cattle. One of the most dreaded of these is the "paardziekte." In the areas where this prevails "salted" horses are of great value. These are the animals which, having recovered from the disease, are immune, a second attack never being experienced. In the valleys of Zululand and elsewhere the plague of the tsetse fly obtains, the bite of this insect entailing a serious disease for the horses.

Ostriches and Ivory

In many regions of Africa the rôle of the horse is taken by the mule, which is bred principally in Algeria and Socotra; and by the asses, which hail for the most part from the Sudan, Abyssinia, and Somaliland. Camels obtain chiefly in the Sudan, Egypt, the north-west of the Sahara, Somaliland, and British East Africa. The area of these animals, however, is rapidly extending, as they are being introduced into the more arid districts throughout the continent. Goats, although they are met with in greater or smaller numbers all over the continent, appear to be principally bred in the Sudan and in British South Africa.

The farming of ostriches is a peculiarly South African industry. Its present importance will be evident when it is explained that nearly £3,000,000 worth of feathers were exported in a recent year. Ostrich farming is chiefly carried on in the Robertson, Montagu, and Oudtshoorn districts. Experimental camps have recently been established on the Shangani River in Rhodesia.

Ivory, which once formed one of the chief sources of African wealth, is now very scarce. The spread of civilisation has inevitably had the effect of reducing the area in which the elephants were wont to range. They are still to be met with in Equatorial and Eastern Africa, and the S.E. Sudan. In order that these animals shall not become extinct the unrestricted shooting of elephants is not permitted in British Africa. W. H. K.

Continued from page 431.

MATHEMATICS:

Contributor: — ARITHMETIC, ALGEBRA, GEOMETRY, CO-ORDINATE GEOMETRY, TRIGONOMETRY, MECHANICS, MENSURATION, ETC.
(M. A. Lewenz, M.A.[Lond.]).

TRIGONOMETRY.—IV

35. Negative lines.

A straight line may be drawn in either of two opposite directions or senses.

Thus the line A B means the line drawn from A to B, while the line B A means the line drawn from B to A.

If one of the two senses in which the line is drawn be regarded as **positive** the other may be regarded as **negative.**

Thus if A B is positive, then B A is negative. They are obviously equal in magnitude, and therefore we may say that A B = − B A.

If A, B, C be three points in any order in the same straight line, then A B = A C + C B in all cases.

Supposing in Fig. 1 A C measures x feet, C B measures y ft.

In Fig. 2 A C measures x^1 feet, C B measures y^1 ft.

In Fig. 3 A C measures x'' feet, C B measures y'' ft.

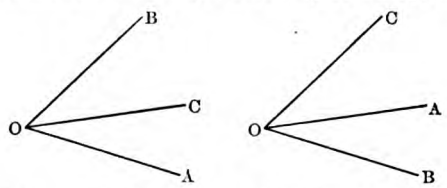
Then taking the direction from left to right as positive in Fig. 1, A C = + x, C B = + y
then A B = $x + y$ = A C + C B

In Fig. 2 A C = + x^1, C B = y^1, A B = + z^1
then A B = + $x^1 - y^1$ = A C + C B

In Fig. 3 A C = + x'', C B = − y''
then A B = + $x'' - y''$ = A C + C B

Thus the angle A O B means the angle generated by the straight line O A rotating about the fixed point O until it reaches the position O B.

If we regard the angle A O B as *positive*, then the angle B O A, which is generated by rotation in the



opposite sense, is *negative*. And since angles A O B and B O A are clearly equal in magnitude, we have angle A O B = − angle B O A.

Hence ∠ A O B + ∠ B O A = 0.

And if there be three straight lines O A, O B, O C drawn in any order from O, then ∠ A O B = ∠ A O C + ∠ C O B.

It is usual to consider angles *positive* which are generated by rotation in the *counterclockwise* sense, and to consider angles *negative* which are generated by rotation in the *clockwise* sense.

37. It is often convenient to keep the revolving lines of the same length, and since an angle is independent of the length of its arms, this will not affect the angles.

Fig. 1.

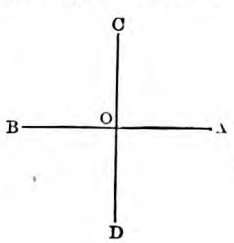
Fig. 2.

Fig. 3.

Starting from an origin O where two straight lines intersect at right angles, it is usual to take all lines drawn in the directions O A and O C as *positive*, and those drawn in the directions O B, O D as *negative*. If lines are drawn in other directions we must state explicitly in every case which are to be considered positive (*see below*).

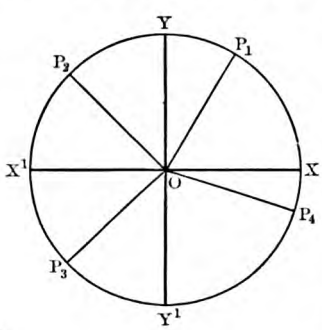
36. Negative Angles.

An angle may be generated by the rotation of a line round a fixed point. This rotation may be in either of two opposite senses, namely clockwise or counterclockwise. The initial and final positions of the rotating line can be indicated by the order of the letters naming the angle.



In this case let O be the centre of a circle having diameters X′ O X and Y O Y¹ at right angles, and let O P be a line rotating round O where P is always on the circumference of the circle.

The circle is divided into 4 **quadrants** by the diameters X¹ O X and Y O Y¹



X Y is called the first quadrant.

Y X¹ is called the second quadrant.

X¹Y¹ is called the third quadrant.

Y¹X is called the fourth quadrant.

The angle X O P_1 is an angle of the first quadrant.

The angle X O P_2 is an angle of the second quadrant.
The angle X O P_3 is an angle of the third quadrant.
The angle X O P_4 is an angle of the fourth quadrant.

Now if the line O P starts from the position O X and makes any number of complete revolutions and then after reaching position O X again rotates further until it reaches the position O P_1 it is clear that X O P_1 is the only geometrical representation of the angle through which O P has rotated, however many complete revolutions O P may have made before stopping in its final position O P_1. Hence when we speak of an angle being in a particular quadrant, we mean that the revolving line stops, or reaches its final position, in that quadrant.

Thus 15^0, 375^0, 735^0, -345^0, -705^0 will all be represented geometrically by the same position of O P, for $375^0 = 360^0 + 15^0$, $735^0 = 2 \times 360^0 + 15^0$, $-345^0 = -360^0 + 15^0$, $-705^0 = -2 \times 360^0 + 15^0$.

If n be any whole number, positive or negative, and α be an angle between 0^0 and 90^0 and θ be its circular measure

Then algebraically

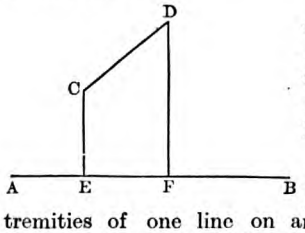
$2n \times 180^0 + \alpha$ or $2n\pi + \theta$ denotes an angle in the 1st quadrant.

$(2n + 1) \times 180^0 - \alpha$ or $(2n + 1)\pi - \theta$ denotes an angle in the 2nd quadrant.

$(2n + 1) \times 180^0 + \alpha$ or $(2n + 1)\pi + \theta$ denotes an angle in the 3rd quadrant.

$2n \times 180^0 - \alpha$ or $2n\pi - \theta$ denotes an angle in the 4th quadrant.

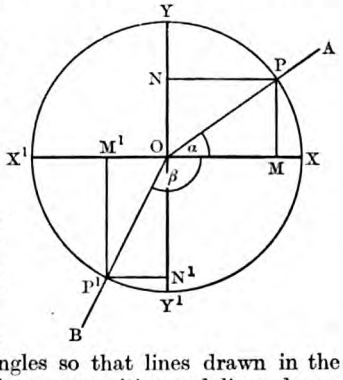
An inspection of the figure will make this clear to the student.



38. The foot of the perpendicular from a point on a line is called the **projection** of the point on that line.

The intercept between the projections of the extremities of one line on another is called the **projection** of the first line on the second.

Thus E and F are the projections of the points C and D respectively on the line A B; and E F is the projection of the line C D on the line A B.



Let a line rotate about O from O X through any positive angle α to the position O A or through any negative angle β to the position O B.

Let Y O Y^1 cut X^1 O X at right angles so that lines drawn in the directions O X and O Y are positive and lines drawn in the directions O X^1, O Y^1 are negative.

Let lengths O P, O P^1 be measured along O A and O B

Let O M, O M^1 be the respective projections of O P, O P^1 on O X

and let O N, O N^1 be the respective projections of O P, O P^1 on O Y

The ratio O M : O P is called the **cosine** of the angle α

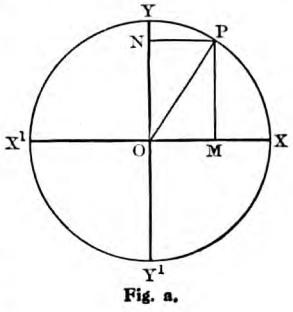


Fig. a.

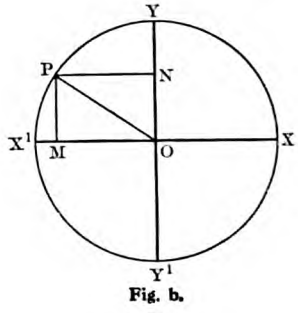


Fig. b.

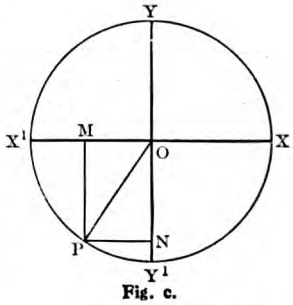


Fig. c.

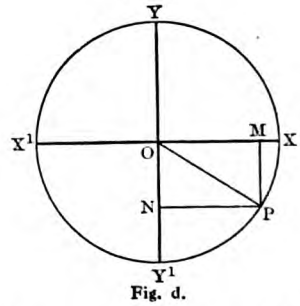


Fig. d.

The ratio O M^1 : O P^1 is called the **cosine** of the angle β

The ratio O N : O P is called a **sine** of the angle α

The ratio O N^1 : O P^1 is called the **sine** of the angle β

The ratio O N : O M is called the **tangent** of the angle α

The ratio O N^1 : O M^1 is called the **tangent** of the angle β

The ratio O P : O M is called the **secant** of the angle α

The ratio O P^1 : O M^1 is called the **secant** of the angle β

The ratio O P : O N is called the **cosecant** of the angle α

The ratio O P^1 : O N^1 is called the **cosecant** of the angle β

The ratio O M : O N is called the **cotangent** of the angle α

The ratio O M^1 : O N^1 is called the **cotangent** of the angle β

These are called the **Circular Functions** of the angles α and β.

39. The signs of the circular functions. Consider the above figures. We suppose the line O P always to be positive. *In the first quadrant*

O M is always positive $\therefore \cos X O P = \frac{O M}{O P}$ is positive (Fig. a).

O N is always positive $\therefore \sin X O P = \frac{O N}{\quad}$ is positive.

$\therefore \tan X O P = \frac{O N}{O M}$ is positive

In the second quadrant

O M is always negative $\therefore \cos X O P = \frac{O M}{O P}$ is negative (Fig. b).

O N is always positive $\therefore \sin X O P = \frac{O N}{O P}$ is positive.

$\therefore \tan X O P = \frac{O N}{O M}$ is negative

In the third quadrant

O M is always negative $\therefore \cos X O P = \frac{O M}{O P}$ is negative (Fig. c).

O N is always negative $\therefore \sin X O P = \frac{O N}{O P}$ is negative

$\therefore \tan X O P = \frac{O N}{O M}$ is positive

In the fourth quadrant

O M is always positive $\therefore \cos X O P = \frac{O M}{O P}$ is positive (Fig. d).

O N is always negative $\therefore \sin X O P = \frac{O N}{O P}$ is negative

$\therefore \tan X O P = \frac{O N}{O M}$ is negative

Clearly sec X O P, cosec X O P and cot X O P will have the same signs as cos X O P, sin X O P and tan X O P respectively. The following table is useful to memorise the signs

	1st *Quad.*	2nd *Quad.*	3rd *Quad.*	4th *Quad.*
Cos	+	−	−	+
Sin	+	+	−	−
Tan	+	−	+	−

To trace the changes in cos θ as θ increases from 0 to 2π

When $\theta = 0$, O M = O P $\therefore \cos \theta = 1$

When $\theta = \frac{\pi}{2}$, O M = O $\therefore \cos \theta = 0$

When $\theta = \pi$, O M = − O P $\therefore \cos \theta = -1$

When $\theta = \frac{\pi}{2}$, O M = O $\therefore \cos \theta = 0$

When $\theta = 2\pi$, O M = O P $\therefore \cos \theta = 1$

Thus the numerical value of cos θ changes from 1 to 0, from 0 to − 1, from − 1 to 0, and from 0 to 1.

Hence the numerical values of cos θ (and also of the other circular functions of θ) are repeated as θ passes through each quadrant.

To find cos 120°

In Fig. 2 above, suppose ∠ X O P = 120°. Then ∠ P O X¹ = 180° − 120° = 60°

Hence $\cos 120^\circ = \frac{O M}{O P} = \cos 60^\circ$ *numerically* $= \frac{1}{2}$ numerically.

But in the second quadrant the cosine is negative

$\therefore \cos 120^\circ = -\frac{1}{2}$.

Exercise 6

(1) Trace the changes of tan θ as θ increases from 0 to π.

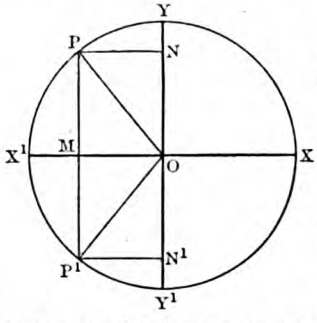
(2) Trace the changes of cosec θ as θ changes from 0 to − π.

(3) Find the sine, cosine and tangent of 225°.

(4) Find the cosecant, secant and cotangent of − 300°.

40. What has been proved above holds good for the circular functions of angles of any magnitude and the formulæ obtained before, such as

$\cos \theta \sec \theta = 1$, $\tan \theta = \frac{\sin \theta}{\cos \theta}$, $\cos^2 \theta + \sin^2 \theta = 1$ and so on can be proved geometrically from the figures.



To prove that $\cos \theta = \cos(-\theta)$ *and* $\sin \theta = -\sin(-\theta)$

Let a line rotate about O from the position O X, through an angle θ to the position O P and through an angle equal to θ in magnitude, but in the *opposite sense* to the position O P¹. Then O P and O P¹ will have the same projection O M on X¹X, and the projection O N of O P on Y Y¹ will equal in magnitude the projection O N¹ of O P¹ on Y Y¹ but will have the opposite sign to O N¹, i.e. O N = − O N¹.

Then $\cos \theta = \frac{O M}{O P} = \frac{O M}{O P^1} = \cos(-\theta)$

$\sin \theta = \frac{O N}{O P} = \frac{-O N^1}{O P^1} = -\sin(-\theta)$

Similarly sec θ = sec (− θ); cosec θ = − cosec (− θ) and tan θ = tan (− θ); cot θ = − cot (− θ)

41. *To prove that* $\cos\left(\theta + \frac{\pi}{2}\right) = -\sin \theta$.

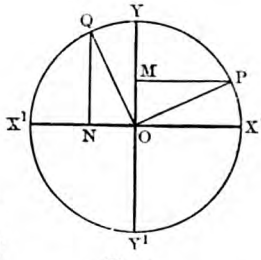


Fig. x.

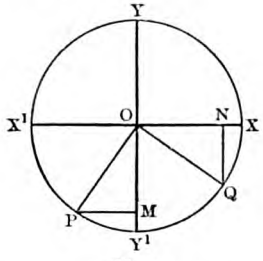


Fig. y.

Let a line rotate about O from the position O X through an angle θ to the position O P.

Let it rotate from the position O P through the angle $\frac{\pi}{2}$ to the position O Q. Let O M be the projection of O P on Y Y¹ and let O N be the projection of O Q on X X¹

Then $\angle$ X O P $= \theta$ and $\angle$ X O Q $= \theta + \frac{\pi}{2}$

In the triangles P O M and Q O N

$\angle$ P O M $= \angle$ Q O N ($\because \angle$ P O M $+ \angle$ Y O Q $= \frac{\pi}{2}$ and $\angle$ Y O Q $+ \angle$ Q O N $= \frac{\pi}{2}$)

$\angle$ P M O $= \angle$ Q N O = a right angle

and O P = O Q $\therefore$ the triangles are equal in all respects

and $\therefore$ O M = O N in magnitude.

Now when P is on the same side of X X^1 as Y, then Q is on the opposite side of Y Y^1 to X, $\because$ in the position O Q the line has rotated 1 right angle further in the positive sense than in the position O P.

$\therefore$ When O M is positive, O N is negative (Fig. *x*).

Similarly when O M is negative, O N is positive (Fig. *y*).

But O M and O N are equal in magnitude

$\therefore$ O M $= -$ O N.

Now $\cos\left(\theta + \frac{\pi}{2}\right) = \cos$ X O Q $= \frac{\text{O N}}{\text{O P}} = \frac{-\text{O M}}{\text{O P}}$

$= -\sin$ X O P $= -\sin\theta$

42. *To prove that* $\sin\left(\theta + \frac{\pi}{2}\right) = \cos\theta$

As before let a line rotate about O from the

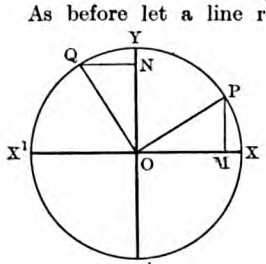


Fig. α.

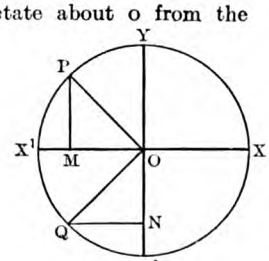


Fig β.

position O X to the positions O P, O Q so that $\angle$ X O P $= \theta$ and $\angle$ X O Q $= \frac{\pi}{2} + \theta$.

Let O M be the projection of O P on X X^1

Let O N be the projection of O Q on Y Y^1

Then as above triangle P O M = triangle Q O N in all respects

and $\therefore$ O M = O N in magnitude.

And when P is on the same side of Y Y^1 as X, then Q is on the same side of X X^1 as Y (Fig. α) since in the position O Q the line has rotated 1 right angle further in the positive direction than in the position O P.

$\therefore$ when O M is positive, O N is positive (Fig. α).

Similarly when O M is negative, O N is negative (Fig. β)

$\therefore$ O M = O N.

Now $\sin\left(\theta + \frac{\pi}{2}\right) = \sin$ X O Q $= \frac{\text{O N}}{\text{O Q}} = \frac{\text{O M}}{\text{O P}}$

$= \cos$ X O P $= \cos\theta$

Now as $\cos\left(\theta + \frac{\pi}{2}\right) = -\sin\theta$, and $\sin\left(\theta + \frac{\pi}{2}\right)$ $= \cos\theta$ it follows that

$\sec\left(\theta + \frac{\pi}{2}\right) = \frac{1}{\cos\left(\theta + \frac{\pi}{2}\right)} = \frac{1}{-\sin\theta}$

$= -$ cosec θ

and $\tan\left(\theta + \frac{\pi}{2}\right) = \frac{\sin\left(\theta + \frac{\pi}{2}\right)}{\cos\left(\theta + \frac{\pi}{2}\right)} = \frac{\cos\theta}{-\sin\theta}$

$= -\cot\theta$

Also $\text{cosec}\left(\theta + \frac{\pi}{2}\right) = \sec\theta$

and $\cot\left(\theta + \frac{\pi}{2}\right) = -\tan\theta$.

43. From the above it is clear that we can express any circular function of an angle in terms of a circular function of another angle that is greater or less than the given angle by one right angle. It follows that by repeated operations of this kind we can increase or decrease the given angle by any multiple of a right angle; further the sign of the given angle may be changed from positive to negative. Thus we have a means of expressing the circular functions of $n\frac{\pi}{2} + \theta$ and of $n\frac{\pi}{2} - \theta$ in terms of functions of θ, n being any integer.

Thus:

$\cos\left(\frac{\pi}{2} - \theta\right) = -\sin(-\theta) = \sin\theta$

$\sin\left(\frac{\pi}{2} - \theta\right) = \cos(-\theta) = \cos\theta$

Again $\cos(\pi + \theta) = -\sin\left(\frac{\pi}{2} + \theta\right) = -\cos\theta$

and $\cos(\pi - \theta) = -\sin\left(\frac{\pi}{2} - \theta\right) = -\cos(-\theta)$

$= -\cos\theta$

and $\sin(\pi + \theta) = \cos\left(\frac{\pi}{2} + \theta\right) = -\sin\theta$

and $\sin(\pi - \theta) = \cos\left(\frac{\pi}{2} - \theta\right) = -\sin(-\theta)$

$= \sin\theta$.

Hence we see that when n is even, the circular functions of $\frac{n\pi}{2} \pm \theta$ are equal in *magnitude* to the same function of θ; and when n is odd the cosine, cosecant and tangent of $\frac{n\pi}{2} \pm \theta$ are respectively equal in *magnitude* to the sine, secant and cotangent of θ. The *sign* of these functions in each case can be determined by reference to the figure in which θ is a positive acute angle.

Examples:—

(1) Simplify $\sin(180^\circ - \alpha)$; here the number of right angles is even $\therefore \sin(180^\circ - \alpha)$ is equal in magnitude to $\sin\alpha$. Again $(180^\circ - \alpha)$ is in the second quadrant $\therefore \sin(180^\circ - \alpha)$ is positive

$\therefore \sin(180^\circ - \alpha) = \mathbf{\sin\alpha}$.

(2) Simplify $\cos(270^\circ + \alpha)$; here the number of right angles is odd $\therefore \cos(270^\circ + \alpha)$ is equal in magnitude to $\sin\alpha$.

Now $270^\circ + \alpha$ is in the fourth quadrant

$\therefore \cos(270^\circ + \alpha)$ is positive

$\therefore \cos(270^\circ + \alpha) = \mathbf{\sin\alpha}$.

(3) Find the value of $\tan 120^\circ$

$120^\circ = 90^\circ + 30^\circ \therefore \tan 120^\circ$ is equal in magnitude to $\cot 30^\circ$. Now 120° is in the second quadrant

$\therefore \tan 120^\circ$ is negative $\therefore \tan 120^\circ = -\mathbf{\cot 30^\circ} = -\mathbf{\sqrt{3}}$.

Exercise 7

Simplify

(1) $\cos(180^0 - \alpha)$. (2) $\tan(180^0 - \alpha)$. (3) $\sec(180^0 - \alpha)$. (4) $\cot\left(\frac{\pi}{2} + \alpha\right)$. (5) $\sin\left(\frac{3\pi}{2} + \alpha\right)$. (6) $\cos\left(\frac{5\pi}{2} = \alpha\right)$.

Find the value of

(7) $\sin 150^0$. (8) $\cos 135^0$. (9) $\tan 210^0$. (10) $\sec 330^0$. (11) $\cot \frac{3\pi}{4}$. (12) $\sin \frac{11\pi}{10}$. (13) $\operatorname{cosec} \frac{5\pi}{3}$.

Key to Exercise 4

(1) $\cos 6\alpha + \cos 4\alpha$. (2) $\cos 7\alpha - \cos 13\alpha$. (3) $\sin 6\alpha + \sin 4\alpha$. (4) $\sin 13\alpha - \sin 7\alpha$.

(5) $\cos(2\phi - 6\theta) - \cos 2\phi$. (6) $\frac{1}{2}\{\sin(60^0 + \alpha) - \sin 3\alpha\}$.

(7) $2\cos 6\alpha \,.\, \cos 4\alpha$. (8) $2\cos 13\alpha \,.\, \sin 2\alpha$.

(9) $2\sin 3\alpha \,.\, \cos\alpha$. (10) $2\sin\frac{3\theta}{2} \,.\, \sin\theta$.

(11) $2\sin(\gamma + \delta) \,.\, \sin(2\delta - \gamma)$.

Key to Exercise 5

(1) 60^0, 30^0, $22{\cdot}5^0$, 270^0, 135^0, $67{\cdot}5^0$, 120^0, 72^0.

(2) $\frac{\pi}{180}$, $\frac{\pi}{6}$, $\frac{\pi}{12}$, $\frac{\pi}{3}$, $\frac{\pi}{4}$, $\frac{2\pi}{3}$, $\frac{3\pi}{2}$, $\frac{11\pi}{6}$. (3) 13·96 feet. (4) 3957 miles. (5) 847849 miles. (6) $\frac{3}{4}$ radian.

M. A. L.

MECHANICS.—VIII

47. We shall now work out a number of problems which exemplify the practical uses of the theories connected with Force which have been discussed in the last lessons.

(1) A train of mass 200 tons is urged forward by a force equal to the weight of $1\frac{1}{2}$ tons, while the resistance it experiences is equal to the weight of 1 ton. How long will it take to acquire a velocity of 10 miles per hour ?

Effective force $= F = \frac{3}{2} \times 2240g - 2240g$

$= 1120g$ poundals

Mass $= m = 200 \times 2240$ lb.

Acceleration (taking $g = 32$) $= a = \frac{F}{m} = \frac{1120g}{200 \times 2240}$ $\frac{\text{ft.}}{\text{sec}^2}$.

$= \frac{32}{400}$ $\frac{\text{ft.}}{\text{sec}^2}$.

velocity $= v = at \therefore t = \frac{v}{a} = \frac{10 \times 1760 \times 3}{60 \times 60} \times \frac{400}{32}$ sec

$= 3$ min. $3\frac{1}{3}$ sec.

(2) A string 2 ft. long, able to sustain a weight of 104 lb. without breaking, is attached to a stone weighing 4 lb., and whirled in a vertical plane round a fixed centre 6 ft. above the ground until it breaks. What happens to the stone ?

The tension T in the string will be the algebraic sum of the centripetal force $F = \frac{mv^2}{v}$ (*see* § 40) and the pull due to gravity.

At A (Fig. 29), F will act in the direction O A, gravity will act in the direction A O, and will $= mg$

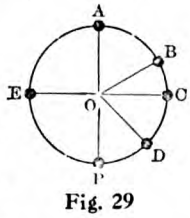


Fig. 29

$\therefore$ at A, $T = F - mg$, i.e. the tension will be least in the position A. At B, $T = F - mg'$ where g' is that part of the acceleration due to gravity which is resolved along O B. At C T = F, for the whole force of gravity acts perpendicularly to O C and therefore will have no component along O C. At D, $F = T + mg''$, where g'' is the component acceleration due to gravity resolved along O D. At P, $T = F + mg$. Here T will be greatest, for clearly g' and g'' are both less than g and $\therefore$ T increases from A until the stone reaches the position P after which it decreases again till we once more reach A.

Hence the string will break when the stone is in the lowest position P.

P is 4 ft. above the ground $\because$ O is 6 ft. above the ground, and the string is 2 ft. long.

The velocity of the stone at P is perpendicular to O P, i.e. is horizontal.

The string will break as soon as T is the least bit greater than 104 lb. weight.

When T = 104 lb. weight, i.e. 104 g poundals, then $F + mg = 104g \therefore F = g(104 - 4) = 100g$

Now $F = \frac{mv^2}{r} = \frac{4v^2}{2} = 2v^2$

$\therefore 2v^2 = 100g \therefore v^2 = 50g = 50 \times 32 = 1600$

$\therefore v = 40$ $\frac{\text{ft.}}{\text{sec.}}$

$\therefore$ the stone will fly off in a horizontal direction with a velocity of 40 $\frac{\text{ft.}}{\text{sec.}}$ at a height of 4 ft. above the ground.

$\therefore$ it will strike the ground at a distance $s = \frac{1}{4}v\sqrt{h}$

$= \frac{1}{4} \times 40 \times 2 = 20$ ft. (*see* § 30).

and the time it will take is $t = \frac{1}{4}\sqrt{h} = \frac{1}{4} \times 2$

$= \frac{1}{2}$ sec.

The path described by the stone will be a parabola.

(3) A man whose weight is n pounds stands in a lift ; if the pressure of his body on the floor of the lift be m lb. weight, find the acceleration with which the lift is moving.

The pressure of the floor of the lift on the man is equal and opposite to the pressure of the man on the floor, i.e. $= mg$ poundals. The only other force acting on the man is his weight $= ng$ poundals.

$\therefore$ resultant force on man $= mg - ng = (m - n)g$ poundals vertically upwards.

$\therefore$ acceleration $= \frac{(m - n)g}{n}$ vertically upwards.

(a) If $m > n$ the acceleration is positive, i.e. upwards.

(b) If $m < n$ the acceleration is negative, i.e. downwards.

(a) is the case when the lift starts to ascend, and when it slows down after descending.

(b) is the case when the lift starts to descend and when it slows down after ascending.

(4) A truck at the end of a railway train becomes uncoupled when the train is going up an incline of 1 in 100 at the rate of 50 miles per hour. Suppose the effect of friction on the motion of the truck is $\frac{1}{200}$ of the weight of the truck, find (1) the length of time during which the truck will continue to run up hill, (2) the velocity with which it will be running down after twice this interval of time has elapsed from the moment when it became uncoupled.

The force on the truck down the hill = mass of truck × component of g resolved down the hill $= m \times \frac{1}{100}g = \frac{mg}{100}$. Besides this the friction $= \frac{mg}{200}$ produces force acting downhill.

$\therefore$ total force acting downhill $= \frac{mg}{100} + \frac{mg}{200} = \frac{3mg}{200}$.

This force acting on mass m produces an acceleration downhill $= \frac{3mg}{200} \div m = \frac{3g}{200} = \frac{3 \times 32}{200} \frac{\text{ft.}}{\text{sec}^2}$

(i) In what time will this acceleration destroy a velocity of $50 \frac{\text{miles}}{\text{hr.}}$? Since $v = at$

$t = \frac{v}{a} = \frac{50 \times 1760 \times 3}{60 \times 60} \times \frac{200}{3 \times 32} = 152\frac{7}{9}$ sec.

(ii) What velocity will the truck acquire running downhill for $152\frac{7}{9}$ sec.?

The force acting downhill due to gravity again $= \frac{mg.}{100}$

But the force of friction, being always opposite to the direction of motion, will act uphill and $= \frac{mg}{200}$

$\therefore$ total force acting downhill $= \frac{mg}{100} - \frac{mg}{200} = \frac{mg}{200}$

In mass m this produces an acceleration $\frac{g}{200} = \frac{32}{200} \frac{\text{ft.}}{\text{sec.}^2}$

In $152\frac{7}{9}$ sec. this acceleration produces a velocity of $\frac{1375}{9} \times \frac{32}{200} \times \frac{60 \times 60}{1760 \times 3} = 16\frac{2}{5} \frac{\text{miles}}{\text{hr.}}$.

(5) A string hanging over a pulley has at one end a mass of 10 lb. and at the other end masses of of 8 lb. and 4 lb.; after being in motion for 5 seconds the 4 lb. mass is taken off; find how much further the masses go before they come to rest.

The forces acting on the 10 lb. are $10g$ downwards and T the tension in the string upwards.

If a be the acceleration of the 10 lb. upwards then

$10a = \text{T} - 10g$ (1)

The forces acting on the $(8 + 4)$ lb. are $12g$ downwards and T upwards.

a is the acceleration of the $(8 + 4)$ lb. downwards then

$12a = 12g - \text{T}$ (2)

From (1) and (2) $10a + 10g = 12g - 12a$

$\therefore a = \frac{2g}{22} = \frac{1}{11}g \frac{\text{ft.}}{\text{sec.}^2}$.

In 5 sec. this acceleration produces a vel. $v = \frac{5}{11}g \frac{\text{ft.}}{\text{sec.}}$.

When the 4 lb. mass is removed the acceleration will be upward, and we have

$10a = 10g - \text{T}$ (3)

$8a = \text{T} - 8g$ (4)

$\therefore 10g - 10a = 8g + 8a \therefore a = \frac{2g}{18} = \frac{1}{9}g \frac{\text{ft.}}{\text{sec.}^2}$

The acceleration $\frac{1}{9}g$ upwards will destroy the velocity $\frac{5}{11}g$ downwards in t sec. where

$t = \frac{\frac{5}{11}g}{\frac{1}{9}g} = \frac{45}{11}$ sec.

In this time s, the distance covered $= vt - \frac{1}{2}at^2$

$= \frac{5}{11}g \times \frac{45}{11} - \frac{1}{2} \times \frac{1}{9}g \times \frac{45 \times 45}{11 \times 11} = \frac{3600}{121}$ ft.

In all problems the student is strongly recommended to work from first principles and not to burden his memory with the more complicated formulæ which he can derive for himself in a moment.

48. When any body, owing to the action of some force upon it, moves through any distance, the force is said to do **work.** In other words:

A force is said to do ***work*** *when its point of application moves through a distance in the line of action of the force.*

The point of application of a force is the particle on which the force acts. When a force acts on a large body, it may be supposed to act upon one particle of the body, and the distance through which it acts is the distance through which the particle moves. It is important to note that this distance is always measured in the direction in which the force acts.

When a body moves in the opposite direction to that in which the force is acting, the force is said to have **work done against it.**

Thus if we lift a heavy body upwards, we do work against the force of gravity. If, on the other hand, a heavy body falls to the ground, the weight of the body does the work.

The work done by a force is measured by the product of the force into the distance through which the point of application moves. That is

$$\mathbf{W = Fs}$$

If we consider work done in the direction in which the force is acting to be positive, then work done in the opposite direction to that in which the force is acting is negative. Therefore work done against a force is the same thing as a negative amount of work done by the force.

Units of Work may be defined as follows:

The **dynamical unit of Work** is the product of the dynamical unit of force into unit distance.

Thus in the F. P. S. system, the dynamical unit of work is 1 poundal acting through 1 foot and is called one **foot-poundal.**

In the C. G. S. system, the dynamical unit of work is 1 dyne acting through 1 centimetre and is called one **erg.** 107 ergs is called one **joule.**

The **gravitation unit of work** is the work done in lifting the weight of unit mass through unit distance.

In the F. P. S. system, the gravitation unit of work is the work done in raising 1 lb. through 1 foot and is called a **foot-pound.**

In the G. G. S. system, the gravitation unit of work is the work done in raising 1 gram through 1 centimetre and is called a **gram-centimetre.**

Examples:—

(1) Find the work done in moving 20 lb. through 3 feet with an acceleration of 10 $\frac{\text{ft.}}{\text{sec.}^2}$

Force $= ma = 20 \times 10$ poundals.

$\therefore$ Work $= F \times s = 200 \times 3 = 600$ foot poundals.

(2) The tide raises a ship of 1600 tons through 12 feet.

Work done $= 1600 \times 2240 \times 12$ foot-pounds.
$= 43{,}008{,}000$ foot-pounds.

To express this in foot-poundals we should have to multiply by 32, the value of g, since the weight of 1 lb. is 32 poundals.

Similarly 1 gram centimetre $= 981$ ergs.

Since the weight of 1 gram $= 981$ dynes.

49. *The rate of work, or* **Power,** *of an agent is the amount of work that can be done by the agent in unit-time.*

The F. P. S. **dynamical unit of power** is 1 foot-poundal per second.

The C. G. S. **dynamical unit of power** is 1 erg per second.

An agent doing 1 Joule or 107 ergs per second is said to be working with a power of 1 watt.

Gravitation unit of power.—The power of an engine is always measured by this unit. It is called a **Horse-power** (H.-P.) and is the rate of doing 33,000 foot-pounds per minute, i.e. in one minute the work done is equivalent to that of raising 33,000 lb. through 1 foot. The French engineers use a gravitation unit of power called a **Force de cheval** which is equivalent to 75 kilogram-metres per second, or 542 foot-pounds per second.

EXAMPLE.—Find the horse-power of an engine which draws a train of 100 tons up an incline of 1 in 60 at a speed of 30 miles an hour, the friction being equal to a drag of 20 lb. weight per ton.

The engine does work in raising the mass of the train 1 foot in 60.

The speed is 30 $\frac{\text{miles}}{\text{hr.}}$ $\therefore$ distance covered in 1 minute $= \frac{1}{2}$ mile $= 2640$ feet.

$\therefore$ train is raised $\frac{1}{60}$ of 2,640 ft. $= 44$ ft. per min.

$\therefore$ engine does $100 \times 2240 \times 44$ foot-pounds of work per minute in raising the train.

Further it does work against the force of friction acting down the plane.

The force $= 20 \times 100$ foot-pounds

$\therefore$ work done against this force in 1 minute = work done in travelling over 2640 ft.
$= 20 \times 100 \times 2640$ foot-pounds

$\therefore$ total work done per min.
$= (100 \times 2240 \times 44 + 20 \times 100 \times 2640)$ foot-pounds

$$\therefore \text{H.P.} = \frac{2000\,(224 \times 22 + 2640)}{33000}$$

$$= \frac{2000 \times 7568}{33000} = 459 \text{ approximately.}$$

Exercise 9

(1) A mass of 200 grams is acted on by a force equal to the weight of 10 grams for 20 seconds. What distance will the mass have passed through and what velocity will it have acquired? ($g = 980$).

(2) Two scale pans each weighing 2 oz. are suspended by a weightless string over a smooth pulley. A mass of 10 oz. is placed in one pan and a mass of 4 oz. in the other. Find the tension in the string and the pressure on each pan.

(3) Two scale pans each of mass 3 lb. are connected by a weightless string passing over a smooth pulley: show how to divide a mass of 12 lb. between the two pans, so that the heavier may descend through a distance of 50 feet in the first 5 seconds.

(4) A body weighing 30 lb. is placed on a smooth horizontal table and has a string attached running parallel to the table and passing over a smooth peg at the edge; a weight of 2 lb. hangs at the end of the string. Find the tension in the string, and the acceleration of the system.

(5) A balloon rises from the ground with an acceleration of 12 $\frac{\text{ft.}}{\text{sec.}^2}$. After rising 96 ft. a stone is dropped from it. How soon will the stone strike the earth?

(6) For how long must a force of 3 lb. act on a mass of 120 lb. to give it a velocity of 960 yards per minute?

(7) A mass of 1 lb. rests on the pan of a spring balance which is falling (1) with a uniform velocity of 10 $\frac{\text{ft.}}{\text{sec.}}$; (2) with a uniform acceleration equal to half that due to gravity; (3) with a retardation numerically equal to g. What will be the indication of the balance in each case?

(8) A stone is whirled round in a vertical circle at the end of a string 21 inches long with a speed that may be regarded as uniform, and makes a revolution every second. The centre of the circle is 4 feet above the ground. Determine the subsequent history of the stone if the string were to break (1) at the instant that the stone was at the lowest point of its circular path, (2) a quarter of a revolution later.

(Questions 7-8 are from the London Matric. Exam.)

Key to Exercise 8

(2) $\frac{4}{9}$ $\frac{\text{ft.}}{\text{sec.}}$ in the direction in which the mass of 8 lb. was moving.

(3) 5,000 units of momentum; $83\frac{1}{3}$ poundals.

M. A. L.

Continued from page 434.

ART AND MUSIC:

Contributors:—THE THEORY OF ART (Hon. John Collier; J. G. B. Lynch). DRAWING AND PAINTING (J. G. B. Lynch). THE THEORY OF MUSIC (R. R. Terry, Mus.Doc., F.R.C.O.; Hubert Grant).

WATER-COLOUR DRAWING.—II

YOUR first care—once you have your materials and implements—will be to exercise the *general* use of them. A brush needs a deal of shrewd handling, and you should learn to lay on a flat even tint before trying anything else.

In the first place take your paper, pin it or strain it on the drawing-board in the way described in the last lesson, go over the surface carefully with a piece of india-rubber, and raise the edge of the board farthest from you so that you get a slope of about 30 degrees.

Next, you should mix your paint. Take sepia, for example, and make enough in one of your saucers or in one of the divisions of your paint-box lid to cover the paper. The right amount you will learn better by practice and by instinct than be definite teaching.

As a matter of fact, a tablespoonful is reckoned to cover a quarter of an Imperial sheet of drawing paper. But it must be remembered that when you are laying on a flat tint you must make all the colour you want *before* using your brush. If you have to start making the colour again there are two disadvantages: firstly, it is exceedingly difficult to match the precise tint you employed the first time; and secondly, you are liable to get a hard edge quickly drying off before you can get your second instalment mixed and ready.

Using a Brush

Begin at the top and draw your full brush across it from left to right. Fill your brush again and work back in the opposite direction; that is, from right to left. Repeat the process, going backwards and forwards over the surface of the paper until it is completely covered. Each time the sweep of your brush should just include the edge of the last stroke—like mowing a lawn.

Each time you should be sure your brush is full of paint, so that you do not have to dip afresh in the middle of a line. The entire paper should be covered by this means. If you have left a white space through carelessness and try to cover it afterwards you only succeed in getting an awkward stain, which gives a blotchy and untidy appearance to the whole sheet.

If you have a redundancy of colour at the bottom edge of the paper, all you have to do is to exhaust your brush on the blotting-paper and pass it along the overcharged edge so that it takes up all the paint that is not required. Leave your drawing-board at the angle in which you have kept it all the time and allow the tint to dry. You will not require a great deal of practice before you can cover all your paper with a perfectly even tint.

The principal things to remember are a *full brush* and *horizontal lines*. These should be invariable for this purpose.

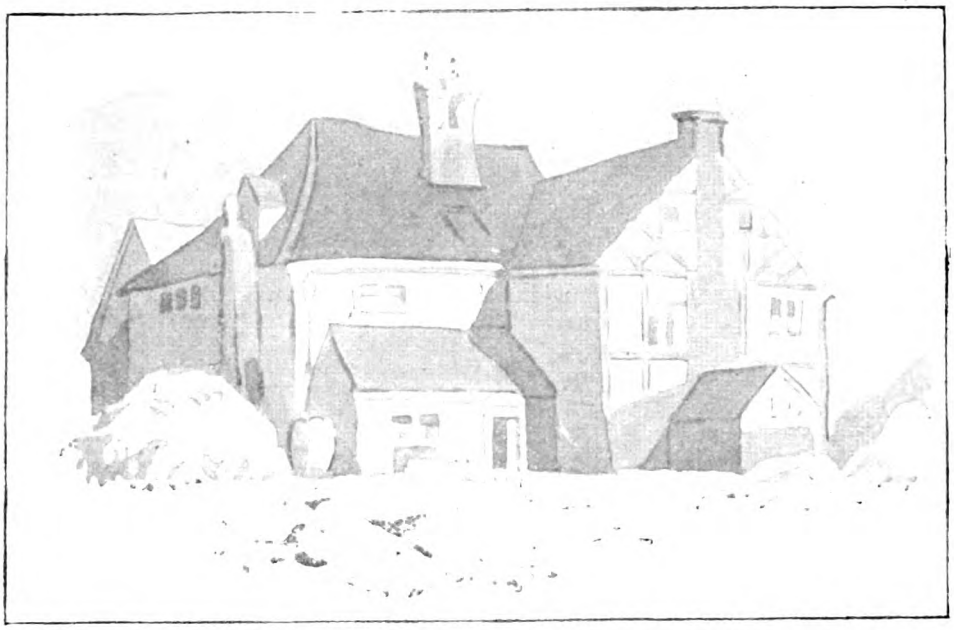
Gradated Tints

You should next practise gradated tints. These, as you will know from your pencil work, are those tints which increase or decrease in intensity as they go down the paper. We will say that you wish to have the tint deepening in tone as it descends the paper. To do this have two or even three partitions in your paint box with the colours mixed in them. Let one contain a weak solution, the next a medium solution, and the third a dark one.

First of all draw your brush across the top of the paper full of water, plain and simple, then use the lighest tint, taking it as far down the paper as you happen to require it; and so on with the medium tint and the dark. Perhaps you may need more than three. In that case, bear in mind that you must prepare for them beforehand. The paper being on a slant causes the colour to run downwards, thus ensuring an even flow. If you wish to begin dark at the top and finish off light, do not forget your brushful of plain water at the bottom.

Your outlines should always be made with an HB pencil. If you use a harder lead, you are apt to make a rut in the surface of the paper which often interferes with the perfect flow of the colour, whilst too soft a lead is apt to become mixed in with the tint and to cause a dirty appearance on the painted surface.

Never shade with your pencil. All shades can be put in more effectively with the brush. Always remember that the outline in pencil must be clear, strong and distinct. You must have no niggling work or small imperfect lines. These always give the appearance of indecisive work, as though



A valuable exercise—which can be carried out in sepia—which will help you to gain experience in the value of tones (*see* p. 494). **The finished drawing is shown below.**

Notice that the cast shadow on the roof is darker than the broad shadow on the wall. This is because a higher part of the house comes between and the reflected light of the roof lightens the tone of the broad shadow.

you were either unable to draw correctly or were not sure what the object you are trying to draw actually is.

But the mere outline is not the only thing to which you should pay attention. There are also the masses of light and shade. You should never do any actual shading with your pencil ; but it is absolutely necessary to mark, faintly yet carefully, the limits of the masses which you will subsequently treat with colour. Also you should mark in the places of the half-tones.

For your first exercises in laying on colour, and in order satisfactorily to learn the management of half-tones, you are strongly recommended to use sepia. This is a transparent colour which flows easily and is capable of showing every possible shade and tone. You should learn the art of rendering semi-tones and half-tints in this one colour before attempting them in the colours natural to the object you are representing. By this means you learn not only to master the use of your brush, but also that highly elusive material—paint-and-water.

Tone and Tint

Tone, it should be remembered, is different from *tint*. Tone is the word used in regard to shade and tint in regard to colour.

Tone is of the first importance, so far as technique is concerned, so you should learn how to deal with tone at the outset.

If you observe the landscape or object which you are going to depict you will notice that it has broad expanses of light and shade. These are subdivided, in a manner of speaking, into a number of different tones of varying intensity. Some lights are brilliant and almost scintillating ; some are a trifle more subdued, some considerably more. Some shades are dark, some are rather less dark, and so on. It all depends on the angle of the rays of light to the object in question. If the face of the object is at right angles or vertical to the source of light, then it gives the most brilliant reflection. The same principle applies in the reverse. And where the surface of the object is rough, some parts of it will be more brightly illumined than others.

Now turn to the sketches on page 493 and copy the top one, making this your exercise in sepia for the practice of tones. The bottom sketch will show you the completed drawing.

First of all, follow the rules laid down above and do your complete pencil drawing. Next make a thin mixture of sepia and water in one of your saucers and with a full brush wash in the background, so that the house stands out in relief.

Remember that your paper on its board should be inclined so that the colour runs downwards. In order to put in the background, take a brush of plain water and go with it over the upper part of the picture from one side to the other. Next take up your sepia and pass the brush across, taking in the lower edge of the water line.

You must take care to outline the house and not to pass the brush over its surface anywhere.

Be careful that the lower edges of your sepia background do not dry hard. Wash them off with a line water, though it is advisable in this instance not to use a full brush. Be careful also that as you put in the sepia you cover all the surface that has to be covered. If you have to touch up the paper afterwards the effect will be spotty and blotchy.

Now do the shadows, both cast and broad. For this you will want a touch more of colour in your mixture, for they must be of a deeper tone than the background and about equal to the shadows at their lightest, so that it will be a middle tone you require here.

Make all the cast and broad shadows of the same tone—on the walls and roof. The same applies to the windows, tufts of grass in the foreground, and so forth. Where a deeper tone is needed run your brush over the painted surface again and yet again if necessary.

But be extremely careful that the tone is even and not blotchy. A paler tone than the background even can be employed for the lighter parts of the house.

This will serve to indicate not so much shadows as weather stains, roughnesses and irregularities in the stonework. You should now complete the picture by a darker tone than any you have used up till now. This will be for touching up details, but you should on no account use your brush for *outlining*.

Outlines

The outlines should always stand clearly in relief by the broad tones which have been carried right up to the edges accurately.

There is a frequent mistake made by beginners who seek to make their pictures the more easily understood by outlining each object with a dark stroke of the brush.

As a matter of fact this usually leads to confusion in the mind of the observer. Instead of a good appearance of perspective such as is given by the right use of flat tones you would get a flat appearance without relief or perspective at all.

You should remember as you study the finished sketch that broad shadows are usually lighter than cast shadows. Notice how the cast shadow on the roof is darker than the broad shadow on the wall. The reason of this is that a higher part of the house comes between and the reflected light from the roof lightens the tone of the broad shadow.

J. G. B. L.

Continued from page 440.

BUSINESS AND COMMERCE:

Contributors:—BOOK-KEEPING (Frederick Heelis, F.C.I.S.). SHORTHAND (by arrangement with Pitman's Schools). COMMERCIAL TRAINING (Arthur Brooke). CHOOSING A CAREER (A. C. Marshall).

COMMERCIAL TRAINING.—XXVIII

WE have already dealt with the question of buying a business; the more difficult question of selling remains to be considered.

The preparatories of selling a business consist mainly of a well and clearly kept set of books which display over a period of years the exact takings from week to week; the half-yearly or yearly profits for the corresponding period; and the existing stock. These books, with the vouchers concerning them, should have been so kept that any qualified accountant could go through them and prepare a digest or report; and, for the purposes of comparison, he would prepare his report from year to year.

Selling a Business

The fact that a business is to be sold may be made known by means of advertisement; by voicing the decision abroad among the commercial travellers; by putting the matter in the hands of a trade agent; and by seeking to sell by private treaty.

Having found a prospective buyer, and satisfied him as to the financial standing and bona fides of the business, the seller must then ascertain the exact standing of the would-be purchaser; and, to do this, he should seek a banker's reference, and make inquiry among the mercantile agencies.

Both buyer and seller being convinced of one another's honest intentions, the matter should be closely discussed and a purchase price fixed; the price being usually dependent upon the capitalised value of the profits averaged over a period of years.

The price paid is naturally for the goodwill of the business mainly; and, in a lesser degree, for the existing stock. It is for the buyer to protect himself against the sapping of this goodwill or connection among customers drawn from the general public; and it would be an offence for the seller personally to approach old customers and to try to draw their custom away from the business of which he has disposed.

The greatest care has to be taken not to offend in this respect; even when the seller is not bound by covenant not directly to compete with the shop he has sold.

So far as leases for business premises are concerned, they usually contain a clause permitting the transfer of the premises to a new tenant—"subject to the landlord's consent in writing, such consent not to be unreasonably withheld." The meaning of the latter provision is that the landlord may not spitefully or maliciously withhold his consent, the new tenant being proved to be satisfactory.

And it must sometimes happen in business that a retailer by his smartness and commercial acumen holds the lease of a shop or shops for a long term, and at a most advantageous price. In such circumstances, it would be perfectly permissible for the old tenant to set a premium upon his lease and to obtain payment for the lease from the buyer of the business.

Salesmanship

A word now regarding salesmanship, the highest of the arts the retailer will be called upon to master.

It would not be going too far to suggest that good salesmanship in the majority of trades commences at the shop windows. The display of goods so made is the magnetic, attractive power to the passer-by; and many a business has been literally built up upon effective window-dressing. In no trade can the shopkeeper afford to neglect his windows; and, when leasing a shop, the size and commanding shape of the windows are points to be considered.

In some trades there are journeymen window-dressers who occupy their entire time in going from shop to shop. They are artists and specialists in window-dressing;

and most of them are able to command a fee of about 1½ guineas per day, with travelling expenses where a shop a considerable distance away has to be dressed. In the large departmental shops capable, original assistants are promoted to be window-dressers and nothing else ; and many such workers can earn from £5 to £8 per week.

Window-dressing must naturally depend upon the particular trade that is followed.

In some circumstances, it is advisable tightly to pack a window with goods in order to carry out a given scheme. At other times the rear of the window may be simply and plainly dressed to form a mere background for the setting-off of some individual article.

Window Dressing

Thus, in the outfitting trade, there might come one week a display of white linen in which shirts, collars, vest slips, waistcoats, cuffs and white ties were tightly arranged in some simple and yet effective design.

The next week, with a background of plain purple cloth, a new line in underwear might be simply displayed in such a way as to arrest the eye. It should be remembered that the chief idea of a smart window is to catch new trade. The retailer may with safety assume that he possesses a certain number of regular permanent customers who will come to him whenever they need anything in his particular line. But it is not sufficient to rely upon these regular customers. Some of them will be moving away from the district ; others will die. Moreover, in no trade can one afford to stand still ; for to stand still in business is inevitably to slip backwards.

Therefore, one must endeavour day by day and week by week to angle for new customers ; and the best way of all to do this is by making a gripping, appealing, irresistible call from one's windows.

And it goes without saying that the window display must be as topical as the morning's newspaper. The changes of the seasons must be carefully noted and anticipated ; and even the time of national rejoicing or mourning should, if possible, be observed and some sort of display made to meet the contingency ; assuming the trade to be adaptable to such alert ideas.

Never copy the nearest competitor ; but, wherever possible, try to anticipate him. Never set out a window display above the means and taste of the district ; but, on the other hand, it is always better to be a shade superior to your neighbourhood than below it.

A. B.

CHOOSING A CAREER.—XXXII

The Mercantile Marine.—To every young Britisher there comes at least once a longing to become a sailor. This passion for the sea is a national characteristic ; but, before a boy takes up this calling as a career, it is essential that both he and his parents shall study the matter most closely, in order to ascertain from which quarter the most lasting results are to be obtained.

In the British Mercantile Marine there are two main classes—those who direct and give orders, and those who execute orders. They form, as it were, the master and man of the service.

We will deal first with the master by explaining how a youth can become an apprentice, then a mate, and finally a captain or master.

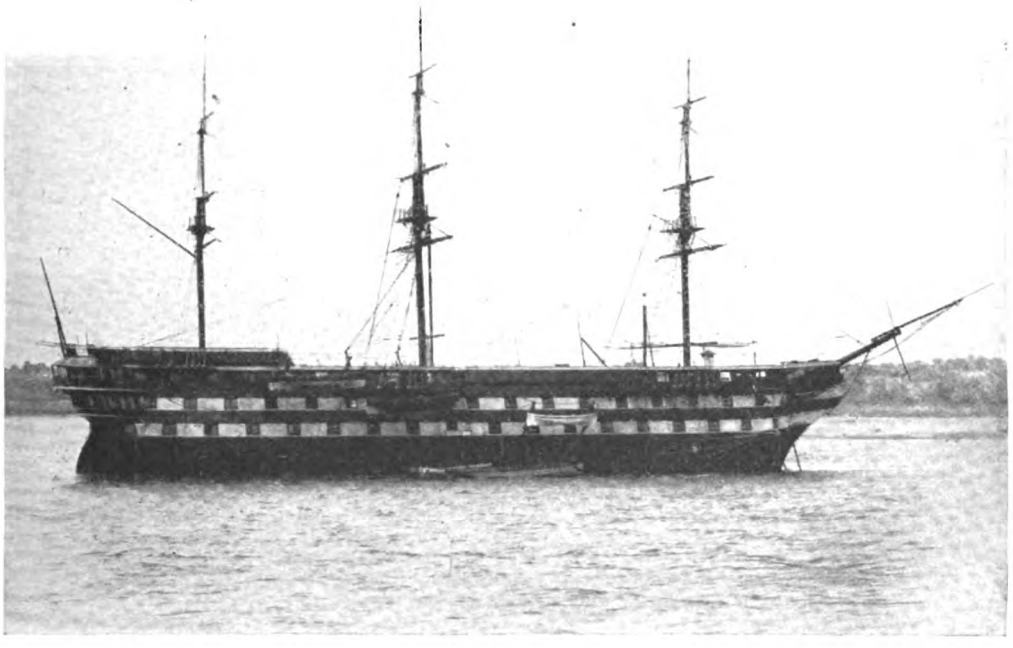
One of the first points to be considered concerns the health of the aspirant ; for it goes without saying that he must be a lad of unusually strong constitution. At the same time, it may be pointed out that youngsters who are physically sound are often liable to bodily ills, so that they are not always robust. In such cases, it is very likely that life at sea would add robustness to the sound constitution ; and doctors will frequently advise a seemingly weak lad to take up the sea as a career.

It will thus be seen that the candidate for a master mariner's ticket should first of all place himself in the hands of the family doctor for a pronouncement as to his fitness or otherwise to go to sea in search of a career.

Particular stress should be laid upon the importance of good eyesight, and complete freedom from colour-blindness ; and it is advisable for a lad to have these matters tested privately before he goes further with the project.

Under the existing Board of Trade regulations, a boy must serve an apprenticeship of four years, unless he has been a pupil for two years on an approved training ship, in which case this two years of tuition counts as the equal of one year of apprenticeship.

There are at least two public training ships for the teaching of boys who wish to become officers in the Mercantile Marine. Of these two, one is the *Worcester*, stationed in the Thames at Greenhithe, Kent ; and the other the *Conway*, lying at Rock Ferry, near Liverpool, on the Cheshire side of the Mersey. In the case of the *Conway*, the age for admission is from 12 to 16 years. The period of training usually lasts about two years, and the fees are pretty much those



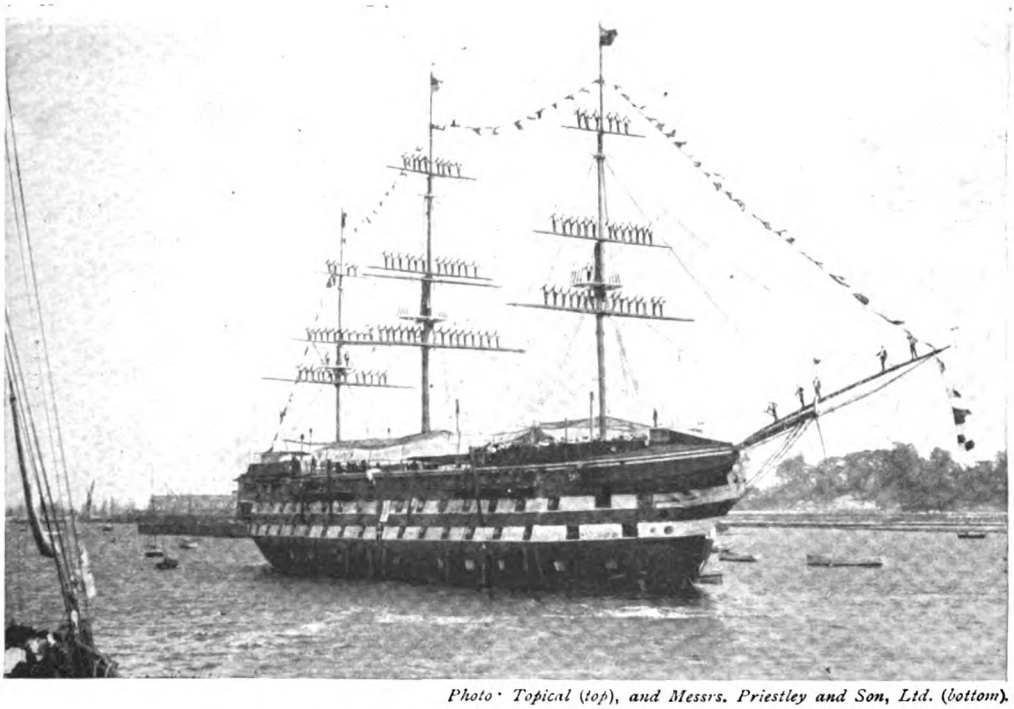


Photo: Topical (top), and Messrs. Priestley and Son, Ltd. (bottom).

THE BRITISH MERCANTILE MARINE

recruits its officers largely from two training-ships—the *Conway* (top photograph) lying at Rock Ferry, Liverpool, on the Cheshire side of the Mersey; and the *Worcester* (bottom photograph), stationed in the Thames at Greenhithe, Kent.

charged at any good-class boarding school. The same remarks apply to the *Worcester*, except that the age for admission is a trifle lower and the period of training slightly longer. The fees are practically the same.

Without a doubt, the training offered in one or other of these ships gives the embryo officer the finest start of all; and every year a certain number of cadets from these vessels are appointed direct to service in the Royal Navy.

The apprenticeship system is naturally a harder school for the young officer, for he is thrust direct into the rough life of the sea. Many practical seamen still strongly advise boys to serve their four years' apprenticeship in sailing vessels in order to obtain a closer knowledge of seamanship; but this is largely a matter of opinion, and apprentices are taken both on steamers and on sailing vessels.

To ascertain the names of companies or individual owners taking apprentices for the Mercantile Marine, one should write to the *Secretary of the Board of Trade, Whitehall, London, S.W.*1, for a copy of the latest official list.

It is frequently the case that a premium is required for indentures of apprenticeship, and that no money allowance is made to the apprentice; in other cases there is a premium to be paid which is returned in the form of small wages; in other cases there is no premium and no wages; and in some instances there will be no premium and yet a trifling wage will be paid.

In all large British ports, however, there is an office of the Mercantile Marine in charge of a superintendent, and would-be apprentices should consult this official at the office nearest their homes for practical advice.

And, wherever possible, a budding apprentice should bring forward all the influence he can. A word from a director of a shipping company will sometimes smooth the way to a sound apprenticeship; and the recommendation of sea captains is in some cases a distinct help.

So far as the large steamship lines are concerned, most of them offer excellent opportunities to boys who will train along their prescribed scale in order that they may eventually enter their service. Both the *Conway* and the *Worcester* stand in high favour with the big companies; and boys who go to the official training schools of the companies from either of these ships are allowed to do so at reduced fees.

Messrs. Devitt and Moore, of 12 *Fenchurch Buildings, London, E.C.*3, have two sea-going ships for the training of officers for the Mercantile Marine; and these ships make frequent voyages, each of about nine months in duration, at inclusive fees. Details of the current fees may be obtained from Messrs. Devitt and Moore; and during the voyages there are school classes and practical tuition and instruction in the various nautical and maritime arts. It is interesting to note in this connection that the Booth Line, the Cunard, the Union Castle and other leading steamship companies have much to do with the fostering of this plan.

On the other hand, the White Star line has a sailing ship for use in the training of cadets for its services. Boys are taken at from 14 to 18 years of age, and their period of instruction counts as their apprenticeship. The fees charged amount to rather over £70 for the first year; rather less for the second and third; whilst somewhere about £45 is charged for the fourth year; *Worcester* and *Conway* cadets being taken at lower fees.

For detailed information and application forms one should write to the head offices of the *White Star Steamship Company at Liverpool.* The *Royal Mail Steam Packet Company, of Moorgate Street, London, E.C.*2, also offers special opportunities to cadets from the two training ships already mentioned; and, in some cases, makes an allowance towards the cost of uniform.

Cadets on any of the training ships are called upon to provide a uniform and outfit, which costs between £30 and £40; and apprentices must also provide a sea-going outfit, at about the same cost. The indentures offered will be those approved by the Board of Trade; and it goes without saying that this document should be carefully studied by the apprentice and his parents or guardians before it is signed.

When the period of apprenticeship has terminated, and provided the apprentice has passed his seventeenth year, he will be eligible to pass the Board of Trade examination for his certificate as second mate.

The pay of officers in the mercantile marine has been on the upward grade for some time.

Captains of liners are paid from £25 to £50 a month; and, in some cases, considerably more; of trading steamers from £20 to £30 a month. Second officers on liners receive from £20 to £35 a month, or more; and on trading steamers £15 to £25. Third officers receive from £10 to £20 a month, according to the class of ship.

At the age of nineteen a young man may take the examination for a first mate's certificate; and at twenty-one that for the master's ticket; and it should be remembered that many important shore posts, such as those of harbour masters, dock superintendents and so on, are open only to retired master mariners who have completed their period of active service at sea.

A. C. M.

BOOK-KEEPING.—XXVI

WE have now dealt with the subject of Depreciation and of reserves for bad debts and discounts, and are in a position to study more advanced Trading and Profit and Loss Accounts. We propose to give *pro forma* Trading and Profit and Loss Accounts, followed by a *pro forma* Balance Sheet of a Limited Company.

PRO FORMA.

TRADING AND PROFIT AND LOSS ACCOUNTS.

Dr. For year ended December 31, 19... *Cr.*

	£	s.	d.	£	s.	d.		£	s.	d.	£	s.	d.
To Stock at Jan. 1, 19..				–	–	–	By Sales				–	–	–
,, Purchases	–	–	–										
Less Returns	–	–	–	–	–	–	*Less* Returns				–	–	–
,, Manufacturing Exp.				–	–	–	,, Stock at Dec. 31, 19..				–	–	–
,, Manufacturing Wages				–	–	–							
,, Gross Profit (Balance to P. and L. Account)				–	–	–							
				–	–	–					–	–	–
To Salaries				–	–	–	By Trading Account (Gross Profit) ..				–	–	–
,, Trade Expenses ..				–	–	–	,, Discount Received ..				–	–	–
,, Rates and Taxes (including Income Tax)				–	–	–							
,, Insurance				–	–	–							
,, General Expenses ..				–	–	–							
,, Discount				–	–	–							
,, Interest and Bank Charges				–	–	–							
,, Depreciation				–	–	–							
Land and Buildings x per cent. on £..	–	–	–										
Plant, y per cent. on £..	–	–	–	–	–	–							
,, Bad Debts				–	–	–							
,, Bad Debts Reserve, z per cent. on £.. ..				–	–	–							
,, Directors' Fees (if provided in Articles) ..				–	–	–							
,, Balance (Net Profit) to Appropriation a/c				–	–	–							
				–	–	–					–	–	–

APPROPRIATION ACCOUNT.

	£	s.	d.	£	s.	d.		£	s.	d.	£	s.	d.
To Directors' Fees (if voted, see P. & L. a/c)				–	–	–	By Balance Jan. 1, 19..				–	–	–
,, Transfer to Reserve Fund				–	–	–	,, Net Profit Dec. 31, 19..				–	–	–
,, Dividend of c per cent. on £.. Pref. Shares				–	–	–							
,, Dividend of d per cent. on £.. Ord. Shares				–	–	–							
,, Balance				–	–	–							
				–	–	–					–	–	–

Pro Forma Accounts

PRO FORMA 1.
BALANCE SHEET
As at December 31, 19...

CAPITAL AND LIABILITIES	£	s.	d.	£	s.	d.	ASSETS.	£	s.	d.	£	s.	d.
Authorised (or Nominal) Capital—							Land and Buildings ..	–	–	–			
— Preference Shares of £– each	–	–	–				*Less* Depreciation ..	–	–	–	–	–	–
— Ordinary Shares of £– each	–	–	–				Plant and Machinery ..	–	–	–			
	–	–	–				*Less* Depreciation ..	–	–	–	–	–	–
Issued Capital—							Stock				–	–	–
— Preference Shares of £– each fully paid ..	–	–	–				Sundry Debtors	–	–	–			
Less Calls in Arrear..	–	–	–				*Less* Bad Debts Reserve	–	–	–	–	–	–
	–	–	–				Unexpired Insurance ..				–	–	–
							,, Rates & Taxes				–	–	–
— Ordinary Shares of £– each paid as to —s. per share	–	–	–	–	–	–	Preliminary Expenses ..	–	–	–			
							Less Amount Written Off	–	–	–	–	–	–
Less Calls in Arrear..	–	–	–				Advertising Expenses ..	–	–	–			
	–	–	–				*Less* Amount Written Off	–	–	–	–	–	–
Reserve	–	–	–				Cash in Hand..	–	–	–			
Added this year (Appropriation Account) ..	–	–	–	–	–	–	Cash at Bank	–	–	–	–	–	–
Sundry Creditors				–	–	–							
Directors' Fees (if as per Articles)				–	–	–							
Profit & Loss Account Bal. on Jan. 1, 19	–	–	–										
Add Profit for Year ..	–	–	–										
	–	–	–										
Less Directors' Fees (if voted)	–	–	–										
	–	–	–										
Less Transfer to Reserve	–	–	–										
	–	–	–										
Less Dividend on Preference Shares	–	–	–										
	–	–	–										
Less Dividend on Ordinary Shares	–	–	–	–	–	–							
				–	–	–					–	–	–

We have seen that the trading concern divides its Revenue Account into two parts, the Trading Account and the Profit and Loss Account.

The Manufacturing Account precedes or supersedes the Trading Account, and its object is to ascertain the cost of Production. If, for example, with a small turnover his works manager receives £500, it will not follow that for double the turnover he will receive £1,000. Therefore with small production the works manager's salary forms a large proportion of cost of production, and this does not increase proportionally with output. Similarly, rent, rates, taxes, lighting, will not increase proportionally, and since comparison in manufacturing is valuable, it is usual to include only such items as increase directly with output, namely **raw materials** and expenses in connection with them, wages,

and the cost of repairs and renewals of plant in the factory or works. The manufacturing account is made up by debiting all raw materials used, carriage in respect of such raw materials, or, more exactly, carriage inwards, workmen's wages, and repairs and renewals. The balance of this account, which represents the net cost of production, is carried into the Trading Account.

The simple way is to think of trading and manufacturing as separate businesses, the former distributing what the latter produces. In large concerns this is what really happens, but in small concerns we have a joint Manufacturing and Trading Account, or Trading Account simply. Indeed, many manufacturers use the expression " Trading Account " in this connection.

Trading Accounts

The purpose of keeping a " Trading Account " is that of recording such items as will enable the business man to ascertain gross profit, or loss, as the case may be.

It is only in certain businesses that a distinct " Working Account " is made, and the items contained in that account depend on the individual manufacturer's outlook. In spite of theory, it is very usual to include as debits cost of lighting works, rent of works, and so on, practically combining manufacturing and trading accounts under the name **Trading** Account.

Consider the following example :—

The Sherbourne Iron Furnace Co., Ltd., has a registered capital of £150,000, divided into 150,000 shares of £1 each ; £120,000 shares, upon which 10s. per share has been called up, have been issued and subscribed. Owing to default by non-payment of Calls, 100 shares, upon which £5 have been received, have been forfeited in accordance with the Articles of Association.

On September 30, 19.., the stock in hand was taken, the value of which, certified by the Managing Director, was as follows :—

	£	s.	d.
Pig Iron	16,045	–	–
Limestone	78	–	–
Coal and Coke	900	–	–
Iron Ore, etc.	1,128	–	–

LEDGER BALANCES (September 30, 19..).
(Not to be copied.)

	£	s.	d.
Freehold Premises Account ..	23,400	–	–
Furnaces, Fixed Plant, and Utensils Account	24,920	–	–
Locomotives and Rolling Stock Account	7,411	–	–
Reserve Account	2,000	–	–
Share Capital Account	59,950	–	–
Wages (Furnaces) Account ..	8,724	–	–
Bills Payable do.	120	–	–
Limestone Stock do.	122	–	–
Coal and Coke Stock Account ..	1,400	–	–
Iron Ore, etc. do. do. ..	1,006	–	–
Pig Iron .. do. do. ..	26,272	–	–
Coal and Coke Purchases Account	27,227	–	–
Limestone do. do.	3,320	–	–
Iron Ore, etc. do. do.	14,467	–	–
Sundry Debtors	7,257	–	–
Profit and Loss Account (Credit Balance)	7,822	–	–
Sales Account	86,873	–	–
Rates and Taxes Account.. ..	1,297	–	–
Repairs and Renewals of Furnaces, etc., Account	2,500	–	–
Repairs and Renewals of Rolling Stock, etc. Account	1,221	–	–
Office Salaries and Sundry Wages Account	1,728	–	–
Travelling Expenses Account ..	237	–	–
Insurance (Fire and Employers' Liability) Account	385	–	–
Law Charges Account	233	–	–
Forfeited Shares Account	5	–	–
Sundry Creditors	5,604	–	–
Bad Debts Account (Debit Balance)	9	–	–
Dividend Account (Paid March 31, 19.., on account of the year ended September 30, 19..) ..	5,995	–	–
Bank Overdraft	1,981	–	–
Cash in Hand	224	–	–
Carriage Account (Inwards) ..	2,000	–	–
Do. do. (Outwards) ..	3,000	–	–

(Royal Society of Arts, Adv.)

Preparing a Working Account

The Ledger Balances on September 30, 19.., set out above, were extracted from the Company's books, after all the necessary trade reserves and depreciations had been adjusted.

Prepare a " Furnaces " (or Working) Account, showing the cost of the Pig Iron produced, also a Trading Account and a Profit and Loss Account for the year ended September 30, 19.. ; and a Balance Sheet as on that date, after carrying £2,000 to the Dividend Reserve Account :—

Dr. IRON ORE ACCOUNT. *Cr.*

19..		£	s.	d.	19..		£	s.	d.
Oct. 1	To Stock b/d	1,006	–	–	Sep. 30	By Stock in Hand c/d	1,128	–	–
Oct./Sept.	,, Purchases	14,467	–	–	Oct./Sept.	,, Stock Consumed, to Mfg. Account	14,345	–	–
		£15,473	–	–			£15,473	–	–
Oct. 1	To Stock b/d	1,128	–	–					

Dr. LIMESTONE ACCOUNT. *Cr.*

19..		£	s.	d.	19..		£	s.	d.
Oct. 1	To Stock b/d	122	–	–	Sept. 30	By Stock in Hand c/d	78	–	–
Oct./Sept.	,, Purchases	3,320	–	–	Oct./Sept.	,, Stock Consumed, to Mfg. Account	3,364	–	–
		£3,442	–	–			£3,442	–	–
Oct. 1	To Stock b/d	78	–	–					

Dr. FUEL ACCOUNT. *Cr.*

19..		£	s.	d.			£	s.	d.
Oct. 1	To Stock b/d	1,400	–	–		By Stock in Hand c/d	900	–	–
Oct./Sept.	,, Purchases	27,227	–	–		,, Stock Consumed to Mfg. Account	27,727	–	–
		£28,627	–	–			£28,627	–	–
Oct. 1	To Stock b/d	900	–	–					

Dr. MANUFACTURING ACCOUNT. *Cr.*

		£	s.	d.		£	s.	d.
	To Iron Ore	14,345	–	–	By Transfer to Trading Account (Pig Iron)	59,881	–	–
	,, Limestone	3,364	–	–				
	,, Fuel	27,727	–	–				
	,, Carriage	2,000	–	–				
	,, Wages	8,724	–	–				
	,, Reprs.& Renewals (Furnaces) ..	2,500	–	–				
	,, Reprs.& Renewals (To Rolling Stk.)	1,221	–	–				
		£59,881	–	–		£59,881	–	–

Dr. TRADING ACCOUNT. *Cr.*

19..		£	s.	d.	19..		£	s.	d.
Oct. 1	To Stock of Pig Iron	26,272	–	–	Oct./Sep.	By Sales of Pig Iron	86,873	–	–
19..					19..				
Sept. 30	,, Amt. Transferred from Mfg. Account	59,881	–	–	Oct. 1	,, Stock c/d	16,045	–	–
Sept. 30	,, P. and L. Account (Gross Profit) ..	16,765	–	–					
		£102,918	–	–			£102,918	–	–
Oct. 1	To Stock b/d	16,045	–	–					

Doubts may be raised as to the advisability of including Renewals and Repairs in the Manufacturing Account. The two items of £2,500 and £1,221 respectively could both be passed to Profit and Loss Account as not varying directly with output. These sums are clearly charges against cost of production, and in a normal year may justifiably be charged as shown, although the effect is to make it difficult to compare percentages of gross profit. Indeed, factory expenses in general may be included in the Manufacturing Account. The second item of £1,221 (repairs to rolling stock) is in reality partly a charge against production, as the rolling stock is used for carriage of raw materials as well as finished products. This amount could be debited to Profit and Loss if the student is doing examination work, but in practice he would be in a position to say who had the benefit of rolling stock. It should always be borne in mind that the essential idea of book-keeping is that of giving results from which can easily be deduced facts and comparisons for future working.

Exercise

Complete the above exercise (as a model) making out the Profit and Loss Account and Balance Sheet.

Key: The Net Profit is £9,876.

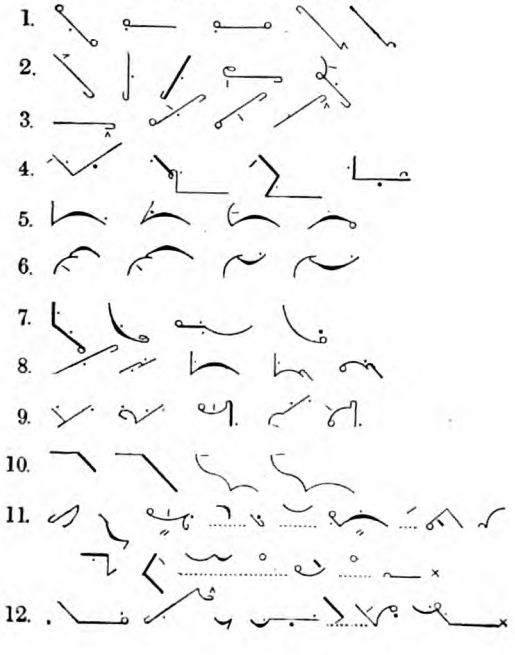
The Balance Sheet Total is £18,363. F.H.

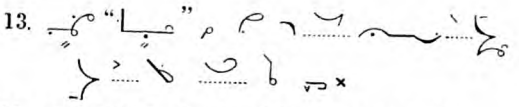
SHORTHAND.—XVI

Key to Exercise 56

1. sceptre, separator, sector, spider, spiders, punter, pounder, pounders.
2. powder, doubter, tutor, bender, render, wonder, yonder, hinders.
3. cutter, papercutter, actor, tractor, subtractor, rector, rectors.
4. plotter, plotters, powders, doubters, daughters, debtors, patter, patters, cater, caters.
5. adventure, adventures, picture, pictures, debenture, venture.
6. matter, mattered, flatter, flattered, order, ordered, pamper, pampered.
7. feather, feathery, inventor, inventory, smoulder, smouldery, winter, wintry.
8. feathers, inventors, winters, hampers, sinkers, lingers.
9. *You-will-be, you-will-be-there, how-can, how-can-there-be, I-have-been, I-have-been-there,* value, value-*their.*
10. *The* cylinders *have-been put on-the* rails *and-they-will-be at-your yard by* 13th December.
11. *We-sent-you word under* separate cover *and* hope *you have al*ready received-*the* hampers *of* fruit.
12. *Your*-letter *of-the* 18th *of* September came *to hand to*-day *and-we-are very*-much obliged *for-your* tabulators *which* arrived *this* afternoon.
13. *The* accumulators *are very* faulty *and-we-are surprised that your* motor stores *should* send *out* such worthless accessories.

Key to Exercise 57

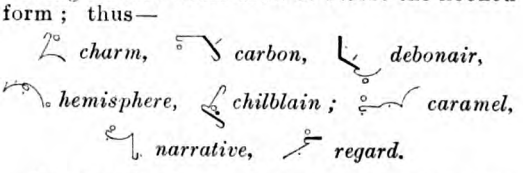




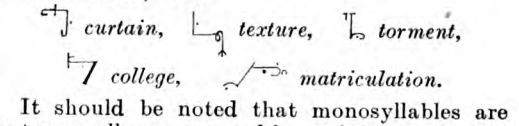
Vocalization of Double Consonants

The forms hooked for *r* or *l* provide facile and legible outlines, and for this reason they are very frequently used. Not only are these hooked forms written for words like *pray, play,* where the two consonants come together, and in words like *term, germ, delicate,* where the vowel *ĕ* intervenes between the consonant and the *r* or *l,* but they may be used when any vowel or diphthong occurs between a consonant and *r* or *l.*

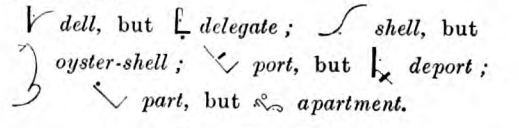
Any intervening dot vowel is indicated by writing a small circle after or before the hooked form ; thus—


charm, carbon, debonair, hemisphere, chilblain ; caramel, narrative, regard.

Any intervening dash vowel or diphthong is expressed by writing the sign through the hooked form, or at the beginning or end of the hooked form ; thus—

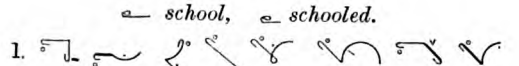

curtain, texture, torment, college, matriculation.

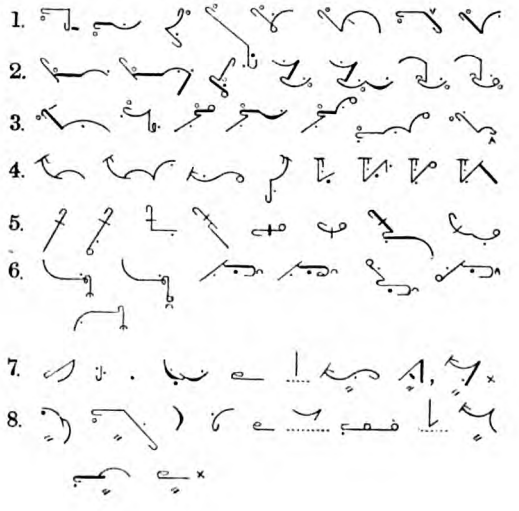
It should be noted that monosyllables are not generally represented by an initially-hooked form ; thus—


dell, but *delegate ; shell,* but *oyster-shell ; port,* but *deport ; part,* but *apartment.*

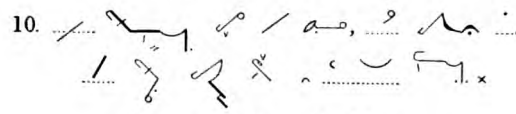
Exercise 58

GRAMMALOGUES


school, schooled.



9.

10. 

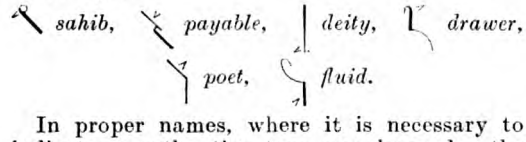
Key to Exercise 58

1. cartoon, garden, sharpen, palpitation, parcel, parlour, carbine, barley.
2. pilgrim, pilgrimage, chilblains, engineer, engineering, mutineer, mutineers.
3. barometer, narratives, regards, regarding, regardless, caramels, paramount.
4. former, formerly, enormous, shorten, tolerate, tolerated, tolerance, tolerable.
5. Church, churches, turkey, purple, coarse, nurse, burglar, furnace.
6. fixture, fixtures, regulation, regulations, speculation, circulation, lecture.
7. *We-shall* attend *the* evening *school at* Norman Road, Norwich.
8. Arthur Carpenter *was* well *schooled in-the* classics *at-the* North Grammar *School.*
9. *We* sailed along-*the* Northumberland coast *in-the* new steamer *called-the* " Charles."
10. *Our* Burgundy wines *are first*-class, *and-as we-have*-made *a large* purchase, *we-shall-be-able-to* supply *you with any* quantity.

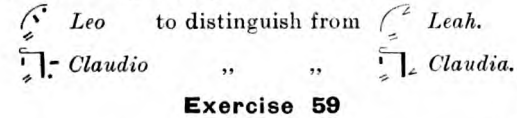
Diphones.—The angular signs are called diphones, and they are written in the vowel-places to represent two consecutive vowels pronounced in two separate syllables; thus—

ah or *ă*	and any vowel	*aw*	and any vowel
ā or *ĕ*	,, ,,	*ō*	,, ,,
ē or *ĭ*	,, ,,	*ōō*	,, ,,

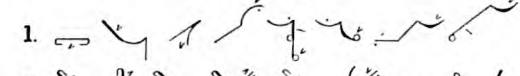
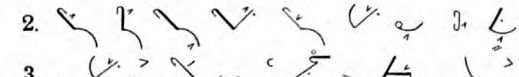
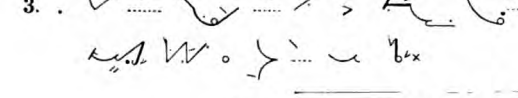
The following examples illustrate the use of these signs—

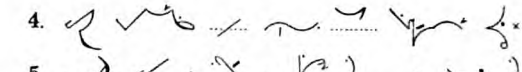
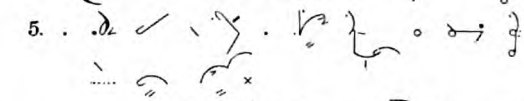
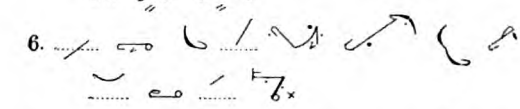
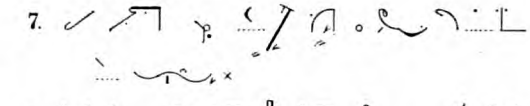
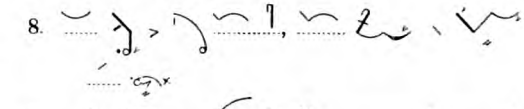
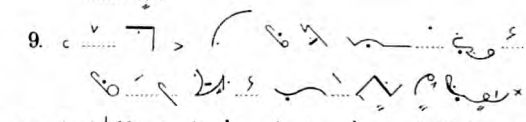
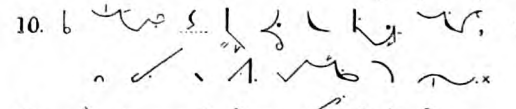
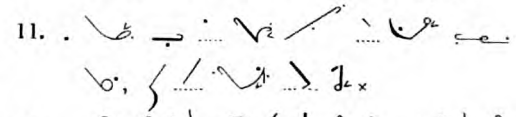
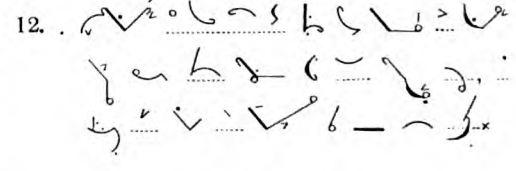


In proper names, where it is necessary to indicate exactly the two vowel-sounds, the separate signs may be used; thus—



Exercise 59

1. 
2. 
3. 

4. 
5. 
6. 
7. 
8. 
9. 
10. 
11. 
12. 

Exercise 60

1. solfa, solfaist, draw, drawing, snow, snowy, envies, envious, reel, really, Dee, idea.
2. Asia, Asiatic, Austria, Austrian, marry, marrying, library, librarian, gaudy, gaudiest.
3. borrow, borrower, Olga, Algoa, billow, billowy.
4. " Alice *in* Wonderland " *was* written *by* Lewis Carroll.
5. *We* sailed *down-the* Suez Canal *in-the* " Montreal."
6. *The* fluid *is a first*-class article *and-we-are-surprised you-should-be* dubious *of-its*-worth.
7. Lewis bought *the* cruet *from-the* jeweller *in* Genoa Road.
8. *We-think-the* premium *is much too high as-the* chances *of* damage *by* hostile air-craft *are very* remote.
9. Marion *is a true* patriot *and* lives *up to*-her ideals.
10. *The* aeronaut *was a* librarian previous *to* joining *the* King's aerial forces.

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